RIG

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FROM THE EDITOR'S DESK

PETER WAKELIN

It has been quite a struggle putting this issue together. That's not been due do any shortage of items to include, but the oppressive heat of July was not conducive to very efficient working. Not only will it be cooler in October when I prepare the December edition but I confidently predict that by then RIG's membership will have topped 2000 for the first time. With such a large membership, many of whom are involved in a variety of disciplines in the remote sensing area, it should be possible to produce a bumper edition of the journal as in December 1994. Please get writing and let me have your contributions by 25 October.

One drawback to having a thicker journal was apparent to a few members last December. Trimming and stitching were unsatisfactory in some cases so we are considering changing to a larger format. This inevitably means a larger area for colour on the covers. How do you think this space for colour should be utilised? Obviously some can be used for satellite images but do you want images that are scientifically meaningful or pretty ones which are impossible to interpret? Please let me know your views.

RIG's own receiver kit has proved to be very popular with well over 200 sold already. The next logical step would be a HRPT kit. Your committee is aware of work being done in the HRPT area by a number of members and feels a degree of co-ordination would be beneficial to all. Anyone able and willing to help in the RIG HRPT project is invited to contact Michael Gill, our Special Projects Co-ordinator (address on page 2). 🌐

NOAA QUESTIONNAIRE

Several years ago some information on RIG members' activities was passed (with their consent) to the World Meteorological Organisation. Now NOAA is undertaking a survey to update these data for the WMO. The data also helps NOAA to provide the best possible service to their users.

Your committee considers it to be in members' best interest that NOAA and the WMO are kept fully aware of the extent of RIG activities and recomends that members complete and return the questionnaire, a copy of which is enclosed with this journal. EU members may, if they wish to reduce postage costs, send theirs to Peter Wakelin (address on page 2), for onward bulk forwarding to NOAA. 🌐

REPORT OF THE 1995 AGM
John Tellick

Henry Neale, the Chairman, opened the meeting at 1610 on 29 April 1995 in the presence of 73 members.

Minutes of the 1994 AGM.

These were agreed by the meeting and signed by the Chairman.

Matters Arising

None.

Chairman's Report

Henry Neale reported that on 2 June he was involved in a car crash which took quite a time to recover from. During the year there had been some changes within RIG which would be dealt with later. He clarified a comment he made at the 1994 AGM about standing down by saying he was willing to serve for some time yet but time creeps up on one and takes its toll.

Treasurer's Report

Mark Clarke began by apologising for not being able to supply copies of the audited accounts due to his recent heavy workload and the longer time needed by the new auditors.

Our turnover for the last financial year - 1 Jan to 31 Dec 1994 - was £85,000 which was about the same as for 1993. Credit card use has increased and now 33% of members use this method for RIG services even with the 3% surcharge (subscriptions excepted). Credit card payments reduce bank charges and a change to a Barclays Community Account will reduce charges further.

Many members had opted for the two-year subscription which is earning interest and helping to keep subscriptions down. Changing journal printers was also beneficial. HM Customs and Excise has looked again at RIG and we have been allowed a 50% reduction in VAT on subscriptions backdated 3 years.

Secretary's Report

John Tellick reported that the two major things to happen were the meeting between RIG and the Radiocommunications Agency (DTI) following about two years of correspondence regarding registration of members' stations and paging interference and a receiver evaluation project undertaken by the RA radio laboratories.

On the registration issue, as reported in RIG 39 we are not considered official users therefore registration is not required. The UK's only registered user is the Met. Office. With the consent of members I supplied the WMO with a list of RIG members and we are therefore 'on a register' somewhere in Geneva with the authorities who are seeking to ascertain the extent of use of the 137-138MHz Meteorological satellite band worldwide.

The RA are well aware of our pager interference problem but, not being official users, cannot take any action.

Regarding the RA RIG receiver project, they were not 'tests' as such but an opportunity for them to look at the performance of four typical receivers and perhaps suggest where improvements could be made to help with the paging transmitter problem. John Reported that a comprehensive report appeared in February which will be summarised in the forthcoming journal. The receivers were found to be adequate for the task but the problem is the close proximity, both in radio frequency and distance, of the receiver to the high-powered paging transmitters.

Some discussion took place regarding registration and schools' use of images and the need to protect the band for the future.

Membership Secretary's Report

Ray Godden said things had gone smoothly during last year. The current membership is 1711 compared with 1501 at the same time last year and is expected to reach the 1994 total of 1950.

Trends include an increased proportion of overseas members; up from 10% in 1992 to 19% so far this year. About 40% have taken up the two year renewal option which gives us already 610 members for 1996. This of course helps with cash flow and eases the renewal workload. Currently, 410 members have not yet renewed for 1995 but reminders will be sent out shortly and we may achieve an 85% renewal rate.

Journal Editor's Report

Peter Wakelin began by saying that the beginnning of the year 1994 coincided with the time that he and Mark took over as the Journal team and we also changed printers. He reported that some early problems had been resolved. A matt paper was introduced in September and a bumper 112 page December issue was issued. The latter received very favourable comment from numerous members.

Peter said that with the increase in membership and the fact that many new members buy back issues we have had to increase Journal print runs. In 1994 it was 2700 and for 1995 it has been increased to 3300. This will hopefully mean we will not have to photocopy Journals in the future. Peter said after he has finished his part he then hands over to Mark who puts it all together and prepares camera-ready copy for the printers. A future aim is to do as much as possible electronically and perhaps send the entire Journal to the printers on a hard disk.

Peter thanked members for their contributions to the Journal and requested they keep them coming in saying it would be nice to have a stock of articles to draw from to create a good balance in each Journal. There is much expertise amongst our membership and it would be good if this was shared via the Journal.

Make-up Editor's Report

Mark Pepper said that we were considering changing the format of the Journal to give us more flexibility with layout. A4 size was being considered which would also alleviate the stapling and trimming problems of thick A5 issues.

There was praise from the floor for the current Journal and one member wished it could be issued every fortnight!

Encryption

Frank Bell summarised events since the EUMETSAT Council's decision about 5 years ago to encrypt the PDUS signals. RIG has run a campaign over the last 18 months or so, written and spoken to all the right people and although encryption is going ahead we feel we have had a significant impact and secured 4 unencrypted slots per day. Amateur and educational users will not be charged a fee for the encrypted data but will still have to pay 700 ECUs for a decryption key.

Frank felt that although we were never going to win, we gave it our best shot and at least now the Met Office, EUMETSAT and the WMO are well aware of RIG.

Some discussion followed during which one member mentioned the probability of decrypted images finding their way on to the Internet.

Nominations for 1995 Committee.

The Secretary reported that all present committee members had indicated that they were willing to stand again. John had received a nomination from Les Currington for Sam Elsdon to join the committee. Henry pointed out that Sheila Newcombe had been co-opted onto the committee during the year and he would also like to have Richard Butler co-opted. Henry suggested that the committee be re-elected en bloc. This was proposed by Trevor David and seconded by Stan Sweatman. All agreed.

Sam Elsdon was nominated by Les Currington and seconded by John Boyer; all agreed.

Any Other Business

In accordance with the rules, two members submitted requests for the following be brought up:

1. Rally sales should be reinstated
2. RIG should attend rallies in the north of Britain.

Mark Clarke explained the reasons behind the committee decision to end sales at rallies and added that only 8 or 9% of respondents indicated in the recent survey that the change would cause them problems. A lengthy discussion ensued during which opposing views were aired.

On the second item, John Tellick explained the difficulties in attending rallies in the north.

At this point Gordon Fleming offered a vote of thanks to the committee for the year's work which was agreed by all.

Frank Bell reported that, following his suggestion, the committee was looking into the possible updating of the Group's rules which had not changed since its inception. Any proposed changes would be published in the Journal.

There being no other business, the Chairman closed the meeting at 1755.

A BRIEF HISTORY OF TIMESTEP'S HRPT SYSTEM

Peter M Arnold, MA

Timestep's first HRPT system was released over 4 years ago in February 1991. Since then we have made a number of substantial improvements to arrive at what we now believe to be the ultimate system for amateur / low-cost use. (That doesn't rule out any more improvements though...). This article concentrates on the improvements to the decoder card, although the development of this is of course linked to other changes to our system. I will attempt to explain the changes made, and also compare the Timestep system with some alternatives.

Our first HRPT decoder board was closely based on the John Dubois design first mentioned in the JESAUG magazine in 1988. A similar board was also sold by Quorum Communications in the USA. The changes that we made were mainly for production rather than performance reasons. The tracking dish we originally used was a 1.6m monster on a huge stand made from welded angle iron. This gave plenty of signal, but was not really a practical proposition for most people. Over the next couple of years, we tried using smaller dishes; first a 1.2m, then one of just 90cm. The 90cm dish worked fairly well most of the time but it was clear that there was very little margin in the system.

In the meantime, we had also developed our Meteosat PDUS system. The PDUS decoder card was originally based on a heavily modified HRPT board, but with a high-performance all-analogue data recovery section to cope with the inherently rather weaker signal. When comparing the two systems, we noticed that the PDUS card would give noise-free images with a much noisier input than the HRPT card would. I then set about trying to improve the performance of the HRPT card, knowing that there seemed to be a good chance of doing so.

The original board was an all-digital design which simply sliced the analogue input with a comparator. This works all right with a strong signal, but is throwing away a lot of the information in the input. With weak signals, all of this information is required to give good results. The PDUS card had used a modified version of the analogue integrate and dump type circuits used by Mike Christieson (Wireless World Aug-Oct 1982) and the University of Dundee ("A Meteosat Primary Data User Station"). Eventually, we came up with a configuration which gave very good results, without being too complicated or difficult to set up. However, it was not possible to simply transfer this circuit to the HRPT card. Because of the 4x higher data rate used by HRPT, it proved necessary to use some (expensive) high-speed op-amps in the filtering and integrator stages, which introduced their own problems of stability etc.

We also investigated alternative solutions. Several recently published designs (in-

cluding that of Guido Emiliani / Claudio Pagnani / Marciano Righini, and also Enrico Falconelli et al) use the Harris HD-6409 Manchester encoder / decoder for combined data and clock recovery. Unfortunately, this chip is not really designed for use with very weak signals. It requires a digital input, meaning that it suffers from the same problem as our earlier board. It therefore seemed unlikely to give us any improvement, although it is a simple solution in applications where there is plenty of signal (i.e. a big dish), or if you don't need to receive satellites at low elevations.

After a lot of work and several prototype boards, we had a system that seemed to work very well. It gave substantially less noise than the older card; in fact measurements suggested that the same amount of image noise was achieved with about 4-5dB less input signal. However, when testing the system for real, we discovered that the improvements had highlighted another problem with our original board. Previously, the phase locked loop clock recovery circuit had worked at signal levels so low as to give unusably noisy images. The improved data recovery now meant that at the level at which the clock recovery circuit just about worked, there was little if any noise. To get even better performance, we needed to improve the clock recovery circuit as well.

There are very few general-purpose phase locked loop chips which work well at the relevant frequency (twice HRPT data rate, 1.33 MHz). The 74HC4046 used on the previous board was awkward to set up at the best of times, and it seemed to be worth trying to find a better-behaved replacement. After some investigations, we settled on the Philips / Signetics NE564. After optimising the input circuitry and loop filter etc, it was apparent that it worked very well, locking even with very noisy signals, giving about a 5dB improvement over the previous card.

The other main improvement made to the system was the development of a helical dish feed for circular polarization. We had previously recommended the use of a 90° combiner and a dual-feed horn to give circular polarization. While this could work well, the large number of connectors required degrades performance slightly. The connectors and combiner also tend to fill with water, which makes things much worse. The helical feed avoids these problems by being inherently circularly polarized. It gives a small but significant improvement over the combiner system at its best, and, more importantly, the performance does not degrade over time. There has also been a change to the 1.7GHz preamp which gives a further small improvement.

So, we now appeared to have an overall 4 or 5 dB improvement in both noise and lock performance from the card, and maybe another 1-2 dB from the feed and preamp. The question is, though, does it work?. Well, the first batch of new boards has now been built. Using a 90cm dish fitted with our new helical feed, and our

automatic tracking system, I have been receiving as many passes as possible. The results are nothing short of astounding. Where there are no trees we can now get noise-free images right down to the horizon. Slight mistracking on overhead passes used to cause a few lines of noise or even total loss of signal; now there is no noise at all. Low passes that we never used to bother with now give almost a full screen of image data. This week we have received images here which show (separately) the eastern side of Baffin Island and a bit of Newfoundland, almost all of Greenland, Cyprus, part of the Nile delta, the eastern end of the Black Sea and the Caucasus mountains, north Africa down to southern Algeria, the Canary Islands and the Azores, and almost everything in between. Some of these areas are a bit noisy, but the real advantage is that passes which used to give poor or non-existent results with the old card now give very good results, and areas which were once slightly noisy at best are now always noise-free. With image resolution as good as 1.1 km (at the image centre) the images are simply brilliant.

The HRPT software has also undergone several important changes since the first version. The AVHRR sensors have a 10-bit data resolution (1024 levels). The transmitted HRPT data stream contains all 10 bits of data for each of the 5 spectral bands (channels) of the sensors. However, it is difficult to deal with 10-bit data. Nearly all computer display systems can cope with a maximum of 256 levels (8 bits). Even 24-bit video cards can only display 256 grey levels. It is therefore tempting to simply discard the two least significant bits, and treat the data as 8-bit. Our early software did this, as do several other systems. We soon realised that this was a mistake. There is much detail hidden in the bottom two bits, and being able to retrieve this is very useful. Even in summer, the data is rarely anywhere near the full 1024-level range, and visible channels in winter can often only have 300-400 levels. Slicing this to 8 bit would give a maximum of just 100 levels, clearly a waste of data. Since September 1992, our software has supported full 10-bit operation, with sophisticated display processing to cope with the amount of data. Another significant enhancement was the addition of land outlines and country boundaries, in April 1994.

Recently, further improvements have been made to the software to improve the on-screen image quality. The zoom scales have been changed so that at a display resolution of 1024x768, screen and image pixels coincide at the second zoom level. Optional cubic interpolation has been added, which gives smoother images, especially near the edges, without any loss of detail. Finally, there is a new contrast-setting facility for greyscale images, allowing non-linear contrast stretches to be made very easily. This can be useful to improve low-level detail without the saturation problem of a linear stretch.

We now finally have a fully automatic tracking system available. This does require the use of a separate computer (that old 286 in the attic?) but means that

unattended reception is now possible. Of course, the improved system performance means that tracking by hand is easier than ever...

The automatic tracking system does mean that you tend to take every pass going. The inconvenience of tracking manually means that you tend to select only the 'best' passes, so you may miss out on some interesting distant areas. We have been using the autotrack unit for some time now, and have included all the features that we think are useful. The software is closely based on our best-selling Track II, so is very easy to use. The autotrack unit itself connects to a serial port on the tracking PC, and to the Yaesu rotator controller. Power is taken from the Yaesu controller. The autotrack unit is based around an 8-bit microcontroller IC, making it easy to upgrade if this is ever required. The software includes an offset facility to remove any dish alignment errors. The offset can be adjusted during a pass to give maximum signal. There is an automatic invert feature for passes which would otherwise cross the rotator's stop at due south; these passes are received with the dish 'upside-down' so the stop is then due north. A calibration mode is included to give maximum resolution and accuracy by matching the rotator position outputs to the autotrack unit.

The improvements made mean that it is now possible to get noise-free images down to very close to the horizon (a few degrees or so). Obviously, any trees or other obstructions will still degrade the signal though. With software features including full 10-bit reception, automatic geometric correction, gridding, outlines, temperature readout etc etc, and the ability to supply a complete integrated system including all cables and other parts, we believe that we now have the ultimate HRPT system for low-cost amateur use. ⊕

MEMBERS' ADVERTISEMENTS

Members may advertise surplus equipment etc. for sale in the Journal free of charge but subject to space being available. Advertisements should be concise and must pertain to RIG activities. They should be submitted to the Journal editor and not the advertising Manager.

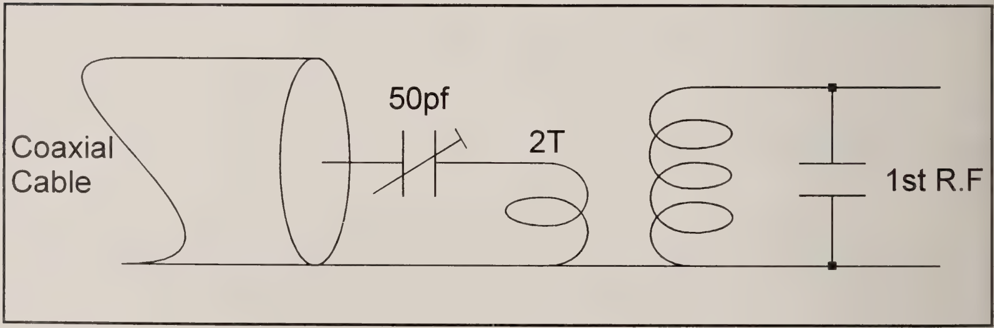
FOR SALE. RIG/DARTCOM equipment: VHF scanning receiver (led), boxed, with controls for remote switching of VHF/UHF antennas; downconverter in w/proof box with co-ax relay and circuitry; VHF masthead pre-amp. £300. SPACETECH podule for Archimedes £100. ACORN AK11 medium res. colour monitor (suits BBC model B), little used. £50 + carriage. 55-element Yagi (1.7GHz) £20 and Lindenblad for 137MHz £5. Buyer to collect antennas. David Newell 01579 (Cornwall) 320602.

MY SOLUTION TO INTERFERENCE

John Tuke

Few of us live in places which are ideal for satellite reception and this is particularly so since the introduction of pagers. I am about 2.5km from London's very busy orbital motorway, the M25, and suffer severely from interference. Until recently, although 137.5MHz was reasonably clear, there was considerable interference on 137.62 and the Russian transmissions on 137.85 were unusable. My first attempt to clear this problem was to build a receiver with two RF stages using lower gain FETs to provide more front-end selectivity. I also built a preamplifier using linear tuned circuits made of silver-plated copper tubing. Although all this improved the situation to some degree, 137.85 was still badly spoiled.

Now I seem to have "cracked" it. The answer was to replace the usual capacity tap aerial coupling with inductive and then to resonate the coupling coil with a small series capacitor. Using the little circuit shown below, the only remaining interference is a very small amount on 137.85MHz until the satellite is above about 10 degrees elevation after which reception is clear. I used two turns on the coil and a 50pf foil trimmer as the series capacitor. Simply tune this for maximum signal. I find this form of coupling does not reduce sensitivity in any way and I can obtain images of parts of Newfoundland from Meteor 3-5 without difficulty. It is worth trying. 🌐



HRPT FOR BEGINNERS
Dave Cawley, Timestep

Introduction
I first wrote about my experiences with HRPT in RIG 23, December 1990. Since then the Membership of RIG has changed significantly and probably 70% of current members will not have read the series of articles. As ever, there have been major changes in the way amateurs receive and process the images, so this is a recap of the last 5 years or so.

John DuBois first wrote about his unique first US amateur reception of HRPT in early 1988. In June of that year I met John and other amateur enthusiasts at the infamous Baltimore conference and listened and watched in awe. After this meeting James Brown and I wrote independently and received a huge wadge of paperwork. We spent nearly all night on the phone with drawings laid out over the floor trying to put the pieces of paper together but failed! At Dayton in 1990 John released comprehensive reproducible circuits and in July 1990 I visited him at his home in Massachusetts to see the system in action and to be briefed on how to get it to work. Peter Arnold and I subsequently refined the system to the current high standard.

Now using home built or commercial equipment, any RIG member can have HRPT AVHRR in their home. When you consider that Norwich Met Office still has no direct reception equipment of any kind, the possibility of amateurs receiving live and processing 1.1km data in their own homes is somewhat startling! Contrast this with just 10 years ago when images of any resolution were processed in low resolution framestores and by photographic paper. How computers have changed our lives for the better.

Satellite and its sensors
All NOAA polar-orbiting satellites have AVHRR (Advanced Very High Resolution Radiometer) sensors that have a resolution of 1.1km in 10 bit data in 5 separate spectral bands. Contrast this with 4km resolution, 8 bit data and 2 spectral bands for APT, an actual advantage to AVHRR of over 20 times! Band 1 is purely visible. Band 2 is visible to near infrared and gives really good land detail and low cloud detail. Band 3 is middle infrared and gives land surface detail and hot spot data such a fires and volcano activity. Band 4 is straight infrared useful for high thin cloud. Band 5 is very little different from band 4.

Transmission format
The satellites transmit on 1698 and 1707MHz using right hand circular polarisation at a data rate of 665kb/s with a modulation format of 67 degrees PSK. The occupied bandwidth is about 3MHz. So before you rush of to listen with your

scanner, remember that the data rate is about 42 times higher than the highest frequency the ear can detect and the bandwidth is 100 times greater than your normal receiver. Five 10 bit bands and telemetry is sent in an interleaved format.

Overall requirements

So, what do you need? Well, it's not impossible to build yourself; just a little time consuming, Peter Hayes and Les Currington have built systems as well as a number of European members. You need an antenna with some gain that also moves, a low noise preamplifier, a very wide band receiver with a PSK demodulator and a computer interface that will provide clock recovery together with bit synchronisation and framing. You can do it yourself, do part yourself and purchase the PC end, or just wind up your credit card and get the whole lot from one of many different vendors.

Antenna

This is a subject of much debate. You can use a single Yagi or even a 60cm dish, but you won't get consistent noise free results from horizon to horizon. Polarisation is a thorny subject, not helped by the fact that I said unambiguously some years back that linear was OK. A single probe in a horn feed illuminating a dish is fine most of the time, and in fact the signal as received is elliptical on the horizon so a horizontal antenna does just fine. But as the satellite passes by and disappears into the trees you need all you can get though. It is almost impossible to make a Yagi give circular polarisation but a very long helical antenna might work as it will be truly circular. Remember that under ideal conditions linear versus circular polarisation will loose you 3dB, which is quite significant. In about 1992 I realised that whatever the pros and cons, circular was, on average, much better and proposed the John DuBois solution of using a horn feed with two probes spaced at 90 degrees fed into a 90 degree combiner giving circular polarisation. This did in fact work and we demonstrated this using a 90cm dish at the RIG conference in Daventry in 1993, despite buildings being in the way and a temporary installation, we got good images live in front of an audience.

All went well until some people noticed their system was not as good as it had been. To cut a long story short, the combiners, cable and horn suffer from expo-

sure to the Sun and rain. Coincidentally we and other people decided that a small helical feed (a very short helical antenna) illuminating a dish should work. Amateur radio operators using Oscar 13 mode S discovered this too, at about the same time. Much work, both theoretical and empirical, resulted in a feed that is simple to make, never goes wrong, has no insertion loss like combiners and is always circularly polarised. This ends up giving over 1.5dB over a good combiner situation, 6.0dB over a bad combiner, and a varying amount from about 2.0 to 7.0dB over purely linear polarisation. Using this helical feed on a 90cm mesh dish has enabled us here in Newmarket to receive HRPT images of the Nile Delta and Baffin Island and other areas sometimes just 0.5 degrees above the horizon. The photograph shows how inconspicuous a 90cm dish is even when mounted at roof level on my bungalow.

Preamplifier and cable

A preamplifier must have a genuine low noise figure; I have measured home-built RIG LNA's at over 3dB. Some manufacturers can offer units as low as 0.5dB. This will help. Since the frequency is close to that of Meteosat on 1691MHz the same unit will cover both systems. But just because you get noise-free Meteosat, don't be fooled into thinking your LNA/Preamplifier is good, it may be, or it may not be. Cable is important, a lot of cable sold these days is not well specified and sometimes incorrectly marked, in fact there is a lot of fake cable, so beware !

Antenna positioner and control

30 years ago radio amateurs moved their long VHF antennas by pulleys and bits of string. Now only computer control will do, even though they complain at the price. You can hold a dish in your hands, have a remote signal strength meter at your feet, and slowly move the antenna across the sky over the 15 minute pass. Or, you could simply purchase a Yaesu R5400 Az-El rotator, which is basically a pair of motors and a control box, and move the antenna a little at a time again watching the signal meter. Or, again you could do the whole lot by computer control and watch the image come in all by itself. Some computer controls rely on third party, or even worse, public domain software. These systems are not tolerant of errors in the original alignment of the dish. Fully integrated systems will alow offsets to be programmed into the tracking software. Kepler elements need to be no more than 2 weeks old and the computer clock should be within 2 seconds, when the satellite is directly overhead the apparent speed of movement is quite high, hence 2 seconds is significant.

Receiver

NOAA transmits on 1698 and 1707MHz with backup on 1702.5Mhz hence it is important that a receiver covers at least these 3 channels. Feng Yun transmitted on 1704.5 with backup on 1695.5 but may or may not ever be replaced. A receiver will usually have a meter to alow easy tracking and a 665 khz TTL data output to

feed the older John Dubois type PC cards and an 665khz analogue (eye) output to feed the newer high performance PC cards.

PC Interface

The PC card performs the difficult task of taking the continuous stream of data and dumping it to the hard disc and simultaneously providing a quick view on the computer screen. Most cards use DMA transfer to put the data on the hard drive. To store all 5 bands and telemetry requires a SCSI II hard drive for the sustained transfer rate. However, most multi-spectral images are taken with bands 1, 2 and 4, hence most hard drives will be OK. The TTL input type cards offer good performance at modest input levels and are fine at above 15 degrees with a 90cm dish. The new generation completely analogue boards will produce images from just 0.5 degrees above the horizon on a 90cm dish. The PC card is the only item most home constructors have to purchase since the technology and software authoring is best left to the professionals.

Software

Early software was not tolerant of signal fades. Newer software will cope with any reception problems and provide stunning results. Each sensor transmits a 10 bit output which is equivalent to 1024 grey levels. Some software simply divides the 1024 levels down to 64 greys. For maximum resolution the active part of the sensor output needs to be divided down. For example this might be between 46 and 580, dividing this smaller number to 64 on screen greys, provides greatly enhanced resolution. Geometric correction of the non-linear sensor scan is a desirable option as is interpolation of data in close-up zooms. Variable non-linear contrast stretching of the data can provide even greater ground feature resolution.

Computer requirements

A humble 386 can be used but as in everything the faster the machine and hard drive the better. If you are not short of time use what you have got. Super VGA is a must though.

What you get

Up to 82Mb of data on a good pass and hours of fun and manipulation from every image. Exporting data to a true 24 bit multi spectral imaging programme provides even further scope. Volcanoes can be detected and in good conditions the path of railway lines and small geographical features such as rivers can be discerned.

Acknowledgments

Over the years Mike Christieson, John DuBois, Edward Murashie, Peter Wakelin, Terry Weatherly, Bob Sansoni and Bob Popham have kept me inspired in my relentless pursual for perfection, and I'm still working on it! 🌐

THE INTERNET (part 3)
Tom Larkin

THE WORLD WIDE WEB

The World Wide Web (WWW) project was started by CERN (the European Laboratory for Particle Physics) with the objective of building an electronic system capable of distributing information easily; they claimed it to be a distributed hypermedia system.

The advantage of such a system is that if you want more information about a particular subject, you can "just click on it" to read further details. In fact documents can be, and often are, linked to other documents by completely different authors; much like footnoting but you can get the referenced document instantly!

To access the web, you need to run a browser program. The browser reads documents, and can fetch documents from other sources. Information providers set up hypermedia servers which browsers can get documents from. Two such browsers are Netscape and Mosaic - both of which are available for a variety of different computer systems (PC Windows, MAC and various UNIX platforms for example). There are many other browsers available, some commercial and others being distributed freely. In fact one of the really exciting things about the World Wide Web is that everything is continually changing, the browser programs, the size of the Web, the number of people using it and the number of sites supporting it.

The browsers can, in addition, access files by FTP, NNTP (the Internet news protocol), gopher and an ever-increasing range of other methods. On top of these, if the server has search capabilities, the browsers will permit searches of documents and databases.

The documents that the browsers display are hypertext documents. Hypertext is text with pointers to other text. The browsers let you deal with the pointers in a transparent way - select the pointer and you are presented with the text that is pointed to. For instance:

Introduction
Chapter 1
Chapter 2
Chapter 3
About the Author

Simply click on any of the hypertext pointers and the corresponding document

would be fetched for you. It would even be possible for the different chapters to be on completely different machines in different countries!

Hypermedia is a superset of hypertext; it is any medium with pointers to other media. This means that browsers might not display a text file, but might display images or sound or animations. This is where the whole business of the WWW comes into its own. It means people can learn about anything though their computer with the medium of sound and vision to assist. For example on clicking 'About the Author' you could be informed of where the author lives, with pictures of his house and surrounding area. You might be presented with a list of furthur books written by him or her and could proceed to read them as well. Personal information such as hobbies, likes and dislikes and so on, may also be at your finger tips!

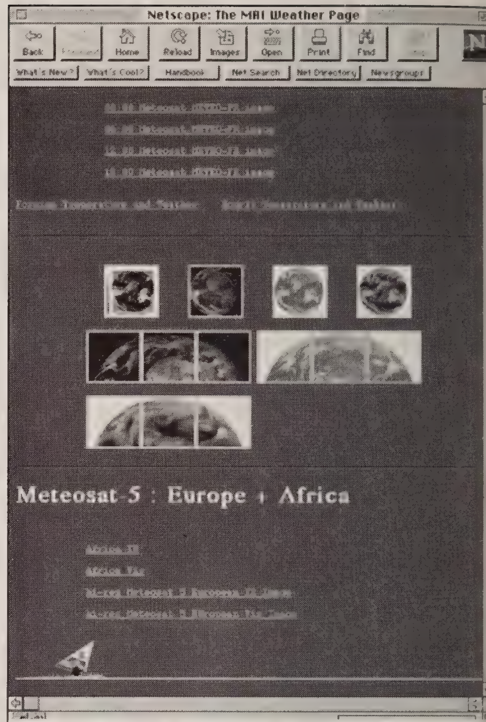


Figure 1

What has all this got to do with Remote Imaging, satellites and RIG? It should be obvious that fairly powerful computers have really come into the price range of most people within the last 5 years and it is a very competitive market. Computers can decode the FAX charts being transmitted terrestrially, the APT transmissions, the WEFAX from the geostationary Meteosat-5, PDUS and HRPT systems are also more common. What happens when someone can provide these images through the WWW? It is a medium whereby the data can be shared for all to use.

Part of my work is involvement in the MSD_RPAS project and figure 1 is a screen capture showing the iconised pictures. This is also an example of a hypermedia document where there is little textual information but there is an intuitive user interface. Information accessible includes Meteosat-5 images every hour in JPEG and GIF format as well as reduced and zoomed versions.

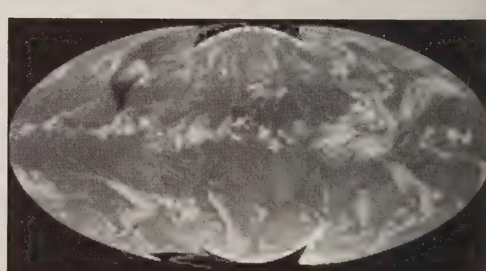


Figure 2

There is a 48 hour MPEG animation generated here as well. Other data not locally produced but mirrored from around the world includes IR and VIS images from GMS-4 and GOES-8, a world mosaic of the Earth (combining 3 different satellites: (MET-5, GMS-4 and GOES-8). See figure 2.

The National Oceanic and Atmospheric Administration (NOAA) has a very impressive web site at the following URL: http://www.noaa.gov/ and the following items are from the 1995 NOAA Strategic Plan which is just one of many topics covered on their server.

Rebuild Fisheries	Seasonal and Interannual Forecasts
Protected Species	Coastal Ecosystems Health
Long Term Global Change	Warnings and Forecasts
Navigation and Positioning	Satellites
Fleet	Environmental Information Services
High Performance Computing and Communications	

It is interesting to note that they are not involved only with the NOAA series of satellites! It quickly becomes apparent that there is a large amount of environmental work done by NOAA.

Another useful contact is the Ionia "1 km" Net-Browser of the European Space Research Institute of the European Space Agency (ESA/ESRIN) service which allows access to:

1, Browse into the data collected through the "1 km AVHRR Global Land Data Set" project (See figure 3).

2, Submit a query to the ESA/ESRIN server (a library of 13,501 quick-look pictures from 25-Mar-1992 to Nov-1993).

Figure 3

3, Visualize the Quick Look images of individual satellite passes collected during the project.

4, Create an order file of the ESA/ESRIN SHARP data products to be processed.

It can be found at: http://shark1.esrin.esa.it/ionia.html

Images of America:

ftp://early-bird.think.com/pub/weather/maps/
ftp://ftp.uwp.edu/pub/wx/
ftp://kestrel.umd.edu/pub/wx/
gopher://wx.atmos.uiuc.edu:70/11/Images/
gopher://metlab1.met.fsu.edu/11/images/
http://www.atmos.uiuc.edu/wxworld/html/satimg.html

Images of Europe:

ftp://ftp.met.ed.ac.uk/
ftp://ccn7.nott.ac.uk/pub/sat-images/
ftp://unicorn.nott.ac.uk/pub/sat-images/
ftp://wilbur.stanford.edu
gopher://cognac-f.epfl.ch:70/11/Divers/meteo/
http://web.nexor.co.uk/users/jpo/weather/weather.html
http://rs560.cl.msu.edu/weather/

Images of the Pacific:

ftp://boa.gsfc.nasa.gov/Weather/gms/ (for use by east America, Europe)
ftp://ftp.gphs.vuw.ac.nz/pub/weather/pictures
ftp://ftp.jcu.edu.au/JCUMetSat/
http://typhoon.reading.ac.uk/weather/weather.html
http://www.rsmas.miami.edu/images.html
gopher://ashpool.micro.umn.edu/11/Weather/Maps
gopher://gopher.uni-bayreuth.de:70/11/Service/Meteosat/
http://rs560.cl.msu.edu/weather/

I recommend the following URL:

http://www.vtt.fi/aut/ava/rs/virtual

for a comprehensive list of sites that contain information on remote sensing. Please remember that the web is changing continuously. Some sites may just be set up temporarly as part of a fun project or may have to be shut down because of too great a load being put onto the server machines.

References:

Welcome to ... Internet : from Mystery to Mastery (MIS Press)
Meteorological-FAQ (by Ilana Stern)

Lycos Web Searcher (Carnegie Mellon)	http://lycos.cs.cmu.edu/
Infoseek Search	http://www.infoseek.com/
NOAA homepage	http://www.noaa.gov/
ESA Iona Project	http://shark1.esrin.esa.it/ionia.html
John Boyer's Satellite Pics	http://www.bbc.co.uk/john_wxpics/

To finish up I would like to especially thank Peter Wakelin for giving me the space in the journal and for his patience and good-will. Thanks also to John Boyer for putting his APT pictures on the Web. If you wish to comment or ask for help please feel free to do so. You can email me at the following address: tlarkin@eisbahn.ucg.ie ⊕

WORLD WEATHER HIGHLIGHTS

May-July 1995

The combination of heavy rainfall and a late, rapid snow-melt resulted in serious flooding in parts of southern Norway with Lillestroem and Hamar particularly badly affected.

The high temperatures in northern India reported last time continued for another month with 46C reported in Delhi - just short of the record set last year.

In China, the annual Yangtse floods were the worst for 15 years, affecting over 100 million people and drowning more than 1,000.

North America experienced some extremes during the period: Northern Mexico enters its fourth year of extreme drought yet New Orleans received 500mm of rain in one day, 9 May! Much of Colorado experienced one of the coldest and wettest Mays on record and most of the mid-west experienced exceptionally high temperatures a few weeks later with many long-standing records broken. There were reports of 700 deaths due to the 40 degree heat in Chicago alone. Ontario province of Canada recorded the highest number of forest fires for 15 years. 16 football match spectators were killed and 22 injured by a lightning strike in a village 400km northeast of Tegucigalpa, the capital of Honduras.

In northern Britain, Manchester airport recorded its warmest night since records began more than 50 years ago. The temperature fell only to 20C early on 31 July; decidedly chilly compared with the 45C, yes, 45C recorded at Phoenix, Arizona at 11pm a few nights earlier. ⊕

THE DESIGN OF PRIME FOCUS FEEDHORNS

Richard Osborne, GW4BVT

Introduction

A number of years ago I acquired a one-metre dish and was offered a feedhorn to go with it. Thinking it would be easy to find a reference book and build my own I declined the offer. How wrong I was! Try as I might I could not find a simple guide to building a feedhorn. So I embarked on my own research program, tracking down every piece of literature I could trace on on the subject. So, from this heady collection of documents I present my own distillation on how to design a feedhorn for a prime-focus parabolic reflector. A number in square brackets [ ] is a reference number, a list of which appears at the end.

What is a Feedhorn?

A feedhorn is a length of waveguide with one open end from which radiation may be transmitted or received. Because the radiation pattern is formed into a beam, a feedhorn possesses gain and directivity like any other antenna such as a Yagi. As Les Currington demonstrated in RIG 32, a feedhorn can be used as a high-gain antenna in its own right, without the need for a parabolic reflector.

The cross-section of a waveguide is normally rectangular or circular. However, provided the cross-section generates the required radiation pattern, it can be any shape. In an ideal feedhorn, the radiation pattern would be a cone which just intercepts the rim of the dish with all the energy contained within the cone. Unfortunately, practical feedhorns do not have a sharp cut-off and a compromise must be found.

This article will concentrate on circular feedhorns as they are most commonly used with dishes.

An Instant Guide to Waveguides

To understand the principle of operation, a brief guide to the behaviour of electromagnetic waves in feedhorns is required.

In free space, an electromagnetic wave consists of an electric field and a magnetic field which co-exist but are constantly varying in amplitude. The relative amplitude of the two is constant and this ratio is known as the intrinsic impedance of free space with a value of 377Ω. The distance between successive peaks in amplitude is the free space wavelength (λ).

In a waveguide, electromagnetic waves travel along it by successive reflections off the internal walls. The waves interfere with each other and set up defined

patterns of electric and magnetic field of which, in theory, there is an infinite number. However, as the free space wavelength increases beyond the diameter of the waveguide, the number of patterns reduces until only one is sustainable. This pattern is called the dominant mode. As the wavelength increases even more, this one pattern cannot exist and the waveguide is then incapable of propagation.

In a circular waveguide, the dominant mode is called the TE_{11} mode which is shorthand for Transverse $Electric_{11}$. This name is derived from the fact that the electric field is always orientated at right-angles to the axis of the waveguide.

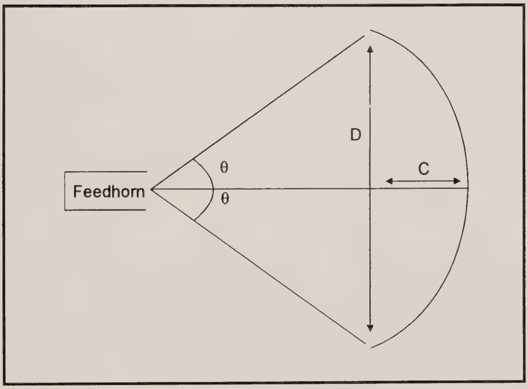
The wavelength inside a waveguide differs from that in free space. Its value depends on the ratio between the waveguide diameter and the free space wavelength. For the dominant mode, it is calculated from the formula

$$\lambda_g = \frac{\lambda}{\sqrt{1 - \left(\frac{\lambda}{1.706T}\right)^2}}$$

where λ = free space wavelength and T = diameter of feedhorn. This value, λ_g is called the guide wavelength.

Diameter of feedhorn

The diameter of the feedhorn determines the beamwidth of the radiation pattern and this must be adjusted to suit a given dish. So, the first task is to determine the semi-angle (θ) subtended at the focal point from the centre of the dish to the rim. The full beamwidth is 2θ.



Measure the dish diameter (D) and the depth at the centre (C). The focal length (F) is $D^2/16C$. The focal ratio, F/D, will usually lie between 0.4 and 0.6. The semi angle θ subtended by the dish is $2 \tan^{-1}(1/(4F/D))$.

The next task is to adjust the beamwidth of the feedhorn so that the efficiency of the overall antenna is at a maximum. Consider the feedhorn as a transmitter rather than a receiver as it has identical properties for both. If the beamwidth is too wide, radiation will pass the edge of your dish and warm up your garden. If it is too narrow, the full surface area of the dish is not utilised. Theoretically, maximum efficiency occurs when the power density is 10dB down at the edge of the dish relative to the centre.

Unfortunately, adjusting the feedhorn so that there is a 10dB power drop at θ off axis will not give the right answer. Because of the geometry of the parabola, the rim of the dish is further from the focal point than the centre. As a result, the power density at the rim is already less than at the centre. This factor is called Space Loss and is a function of the angle θ. The equation in dB is $20 \log_{10} [\sec^2(\theta/2)]$. In case you have forgotten, sec(ant) is 1/cos of an angle. Subtracting the space loss from 10dB gives the required power drop at angle θ.

To enable the radiation pattern to be calculated, the electromagnetic field in the waveguide must be restricted to the dominant mode which I mentioned earlier. This is done by keeping the diameter between 0.58 and 0.76λ. However, as the lower limit is approached, the guide wavelength increases rapidly as do electrical losses so I would not recommend going below about 0.63λ. Contrary to intuition, the beamwidth is inversely proportional to to the diameter so increasing the diameter reduces it. If a diameter of greater than 0.76λ is required, the feedhorn must be flared at its open end to preserve the dominant mode.

Now comes the difficult bit. None of the texts that I have read gives simple design rules for calculating the beamwidth. The RSGB VHF/UHF manual gives a couple of simple formulae but I believe that they are being applied incorrectly as they are only valid where where the diameter exceeds 1λ. Others seem to imply that any old coffee can will do. I suspect the problem occurs because, unlike a wire antenna, a precise result is almost impossible to achieve because of distortions in the field at the mouth of the feedhorn and currents flowing on the outside etc. The best I can do is to follow the University of Dundee [4] in their report for ESA which uses formulae derived by Chu [9].

Table 2 shows the solutions to these formulae for a range of waveguide sizes which are given as the ratio between the diameter of the feedhorn divided by the free space wavelength of the wanted frequency (D/λ). Both must be in the same unit of length. Next to this is the guide wavelength relative to the free space wavelength (λ_g/λ). After this, the relative reduction in dB at a given angle off axis is shown. Separate figures are shown for the E and H field planes because their rates of change with angles are different. The E field lies in the plane of the coupling probe (more about this below) and the H field is at right angles to this. I

have restricted the angle range to 40° to 75° as this covers the F/D range 0.35 to 0.7 which most dishes will occupy. The space loss for each angle and corresponding dish F/D is shown at the bottom of the table.

As an example, suppose you have a dish with an F/D of 0.4. Applying the formula above gives a semi-angle θ to the rim of 64°. The space loss is 2.9dB so subtracting this from the required 10dB power drop at the dish rim gives 7.1dB. Now look through the charts for the table which gives power drop derived from the mean of the E and H planes of 7.1dB at 65° (closest angle to 64°). The table with a diameter/wavelength ratio of 0.72 gives the closest result. Multiply the free space wavelength by the ratio to derive the physical diameter of the feedhorn. By good fortune, the beamwidths for the E and H fields are almost identical at this point which will give even coverage of the dish.

If you check your current feedhorn and find that it does not appear to have the optimum dimensions there is no need to replace it. A deviation at the rim of 2dB from the nominal 10dB is likely to reduce the overall efficiency of the antenna by only 1% or 2%.

Length of Feedhorn

I can find no consistency in all the references that I have read on determining the length of the feedhorn. The VHF/UHF manual [7] says greater than one guide wavelength, Satellite Experimenters' Handbook [8] quotes between 0.5 and 1.5 guide wavelengths and so on.

There must be a minimum length otherwise the feedhorn would be unable to operate as a waveguide. There is no theoretical maximum length other than that dictated by transmission losses and twisting of polarisation in circular waveguides. To ease mechanical construction, the feedhorn needs to be as short as possible while maintaining the required internal field.

At the low microwave frequencies used by Meteosat, the RF coupling into the feedhorn is made by a short probe which is fed by coaxial cable. As with any other type of antenna, maximum efficiency occurs when the input impedance of the probe matches that of the cable (usually 50Ω). However, this matching is not only affected by the size and position of the probe (more about this below) but also by the match between the internal impedance of the feedhorn at the open end and that of free space (377Ω). (Note. Impedance in a waveguide is the ratio of magnetic to electric field strength equivalent to current to voltage in a cable).

Work on the problem has been done by DJ1SL [1] who experimented with various feedhorn lengths while measuring the VSWR match (return loss) between the coaxial cable and feedhorn. He noticed that a natural peak in the return loss (mini-

mum VSWR) occurred when the feedhorn was a half guide wavelength long and suggested this was caused by a match between the internal impedance of the feedhorn and free space. Also, the usable bandwidth was greater than that of a feedhorn with arbitrary length so I would recommend making the feedhorn half the guide wavelength long. The ratio of guide wavelength to free space wavelength is given in Table 2 for each diameter/free space wavelength ratio.

Position of Probe

The probe can be thought of as a monopole antenna over a ground plane. Its function is to couple the EM radiation in the feedhorn into the coaxial cable. The general references state that the probe should be located a 1/4 guide wavelength from the closed end of the feedhorn where the electric field intensity will be at a maximum. However, in designs which I believe have been optimised with test instruments (see Table 1), the probe position is clearly not there. In fact it is about a 1/4 *free* space wavelength from the closed end. So what is going on?

With a feedhorn that is only a half guide wavelength long, I believe that the EM field pattern is unable to develop into the pretty patterns shown in textbooks. Also, a good proportion of the dish is directly visible to the probe so it is receiving a mixture of direct radiation reinforced by reflections off the closed end and waveguide directed radiation. Finally, the presence of the probe itself distorts the local field pattern just to add further confusion.

If the length of the waveguide is increased, the probe will need to be moved towards the 1/4 guide wavelength position. In Table 1, you can see that the probe has moved towards this position in the feedhorn of [3]. Unfortunately, I know of no simple (or even complicated) formula for locating the probe. The only guaranteed method is to use a return loss analyser and adjust the probe position for maximum loss. Failing this, copy a design where the author states that this has been done.

Size of the Probe

The probe acts as a 1/4 wavelength monopole over a ground plane. Its actual length will be about 0.22 times the free space wavelength because of self capacitance effects. For Meteosat the length will be about 39mm. Ideally, make the length adjustable by using brass rod which is tapped to take a brass tuning screw. An alternative to tapping is to solder a brass nut on top of hollow brass rod available from hobby shops.

The diameter of the probe is not critical. In free space a diameter equal to 0.2 x length will give broadest bandwidth and lowest VSWR. However, a probe of this size may well upset the the waveguide field pattern so a good compromise is 0.1 x the length of the probe. For Meteosat, a probe diameter of 4mm will allow a screw

to be fitted comfortably.

Circular Polarisation

Circular polarisation is obtained by fitting two probes at right-angles and combining the signals with a 90° phase difference. This difference can be induced by a Mini-Circuits ZAPQ-2 combiner. Alternatively, use unequal lengths of coaxial cable with due allowance for velocity factor to induce the phase shift and then join the cables in a combiner which provides the impedance matching. Examples of an air cored combiner appear in [7] and a microstrip combiner in [10]. Incidentally, the latter reference also gives details of building and stacking loop Yagi antennas.

Building Prototype Feedhorns

One way of finding your feedhorn is to go round supermarkets and DIY stores with a tape measure checking all the metal coffee tins and paint tins you can find. Unfortunately, the men in white coats will soon be after you. I built my original feedhorn out of thin tin-plate. Work out the dimensions of the unrolled wall of the feedhorn and cut a rectangle of the required size. To obtain a clean edge use a metal guillotine. If you do not have immediate access to one, try your local school or technical college. Next, roll the plate into a tube. A sheet-metal roller is useful but not essential as I fashioned my feedhorn round a cardboard tube by hand. Butt the straight edges of the tube together and solder the seam along its length. I found that a normal temperature-controlled iron was perfectly adequate. Cut a circle out of tin-plate to fit in one end of the tube and solder into position. Finally, cut a hole for the probe and supporting connector and solder the connector into position.

References

[1] Tubular Radiator for Parabolic Antenna on the 13cm Band. HJ Greim, DJ1SL. VHF Communications 4/1976

[2] ARRL Handbook 1988 Chapter 23 page 23

[3] ARRL Handbook 1988 Chapter 23 page 24

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[6] HRPT Receiving System. E Emiliani, C Pagnani, M Righini. RIG Journal no. 25

[7] VHF/UHF Manual 4th edition. Chapter 9. RSGB

[8] Weather Satellite Handbook 4th edition. Ralph Taggart. ARRL

[9] Calculation of the Radiation Properties of Hollow Pipes and Horns. LJ Chu. Journal of Applied Physics Sept 1940.
[10] Loop Yagi Antenna Design for 13cm. J Grimm DJ6PI. VHF Communications 2/1985

TABLE 1

Comparison of Published Feedhorn Designs

FEEDHORN	D/λ	Feedhorn Length λ_g	Probe Position λ	Probe Length λ
[1]	0.675	0.50	0.25	0.20
[2]	0.697	0.54	0.25	0.22
[3]	0.645	0.80	0.55 ($0.23\lambda_g$)	0.21
[4]	0.690	0.45	0.27	0.23
[5]	0.750	0.47	0.25	0.21
[6]	0.675	0.48	0.25	0.22

TABLE 2

Variation of Feedhorn Radiation Pattern with Diameter

D/λ	λ_g/λ	40°		45°		50°		55°		60°		65°		70°		75°	
		E	H	E	H	E	H	E	H	E	H	E	H	E	H	E	H dB
0.60	4.68	2.0	2.9	2.5	3.7	2.9	4.5	3.4	5.5	3.9	6.5	4.3	7.7	4.7	9.0	5.1	10.6
0.62	3.07	2.3	2.8	2.8	3.5	3.3	4.3	3.9	5.2	4.4	6.1	5.0	7.2	5.5	8.4	5.9	9.7
0.64	2.50	2.5	2.8	3.1	3.5	3.7	4.2	4.3	5.1	4.9	6.0	5.5	7.0	6.0	8.1	6.6	9.3
0.66	2.18	2.7	2.8	3.3	3.5	3.9	4.2	4.6	5.1	5.3	6.0	5.9	6.9	6.5	7.9	7.1	9.1
0.68	1.97	2.8	2.8	3.5	3.5	4.2	4.3	4.9	5.1	5.6	6.0	6.3	6.9	7.0	7.9	7.6	9.0
0.70	1.83	3.0	2.8	3.7	3.5	4.5	4.3	5.2	5.1	6.0	6.0	6.7	6.9	7.4	7.9	8.1	9.0
0.72	1.72	3.2	2.9	3.9	3.6	4.7	4.4	5.5	5.2	6.3	6.1	7.1	7.0	7.9	8.0	8.6	9.0
0.74	1.64	3.4	3.0	4.1	3.7	5.0	4.5	5.8	5.3	6.7	6.2	7.5	7.1	8.3	8.0	9.1	9.0
0.76	1.57	3.5	3.0	4.4	3.8	5.2	4.5	6.1	5.4	7.0	6.3	7.9	7.2	8.8	8.2	9.6	9.1
0.78	1.52	3.7	3.1	4.6	3.8	5.5	4.6	6.4	5.5	7.4	6.4	8.3	7.3	9.2	8.3	10.1	9.3
0.80	1.47	3.9	3.2	4.8	3.9	5.8	4.8	6.7	5.6	7.7	6.5	8.7	7.5	9.7	8.4	10.6	9.4

	40°	45°	50°	55°	60°	65°	70°	75°	
SPACE LOSS	1.1	1.4	1.7	2.1	2.5	3.0	3.5	4.0	dB
F/D RATIO	0.69	0.60	0.54	0.48	0.43	0.39	0.36	0.33	

INTERPRETING WEATHER SATELLITE IMAGERY - PART 12

Peter Wakelin

"Mist or low cloud will develop overnight but will burn off quickly in the morning" and "The low cloud affecting much of the country will burn back to the east coast during the day" are expressions sometimes heard in radio and TV weather forecasts. Although I am sure that no readers envisage combustion and oxidation playing any part in the process I will try to explain simply what happens.

During this year's tennis championships at Wimbledon, a large anticyclone was slow-moving near the north of the British Isles and, quite unusually, there was no disruption to play due to rain. However, many mornings started dull and overcast but it was fine and hot by the time play commenced. On 26 June I took a sequence of images from all four operating NOAA polar-orbiting satellites which well illustrated the dispersal of low cloud over the course of a few hours. However, before coming on to the images, a little basic meteorology is needed.

At typical surface pressures, a kilogram of dry air (about 1.5 cubic metres) can hold, in vapour form, about 4g of water at a temperature of 0C, 8g at 10C, 15g at 20C and 27g at 30C. Fortunately, surface air does not usually hold the maximum amount possible. The ratio of the weight of water *actually* held by a sample of air to the amount it *could* hold is called the Relative Humidity (RH) and is normally expressed as a percentage. So, from the figures above, if 1kg of air at 20C contained only 10g of water it would have 67% RH. Now because air at 19C can hold less water than air at 20C, if the air is cooled by one degree the RH will rise. There must be a temperature at which our 1kg of air can only hold 10g of water and when cooled to this point, known as the dewpoint, the RH will be 100%. Further cooling will result in the formation of liquid water.

When air passes over a colder surface, heat transfer takes place and the air is cooled. As cooler air is more dense, it tends to remain at the surface so cools even further. The depth of this cold layer varies considerably dependent, in part, on the wind speed. When stationary air over a cooling surface, such as open ground under a clear night sky, gives up its heat to the surface, a very shallow cold layer just a few metres deep forms and cooling to the air's dewpoint results in the formation of dew or frost. When a very little wind is present, the cooling is spread over a deeper layer, typically 100m, but with a smaller temperature drop and in this situation the formation of fog is a likely outcome. In a stronger wind, turbulence will extend the cooling over perhaps 500m in which case only the top of the cooled layer may be at 100% RH. In this situation, there may be a layer of "fog" above ground level where it is, of course, called cloud. High ground may penetrate into this layer, or even through it, and experiences hill fog.

As a general rule, the temperature of the atmosphere decreases with increasing height at an average rate of around 6C per kilometre. Where this trend is reversed, or inverted, and the temperature rises with height, such as above a cold surface layer, a temperature inversion is said to exist. Instruments called radiosondes are carried aloft by balloons two or more times a day from hundreds of sites around the world to measure the temperature and moisture content of the atmosphere as they ascend. Also, by monitoring the track of the balloon during the ascent it is possible to derive upper wind information as well. These days the computations are fully automated and encoded messages full of information are passing through computers around the world within an hour or so of the balloon's release.

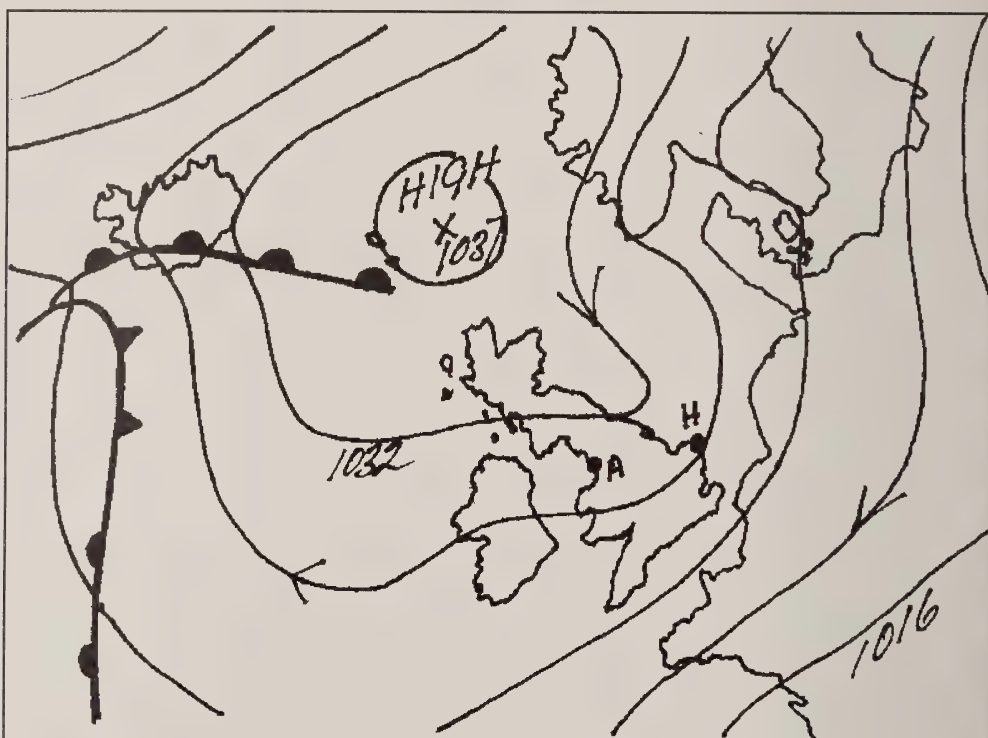


Figure 1

Figure 1 is based on the 1200 UTC surface analysis chart for 26 June prepared at Bracknell Met Office Headquarters. An easterly flow is blowing across most of Britain around an anticyclone situated east of the Faroe Islands. I have mentioned several times previously in this series how anticyclones are associated with huge areas of gently descending air which dries and warms as it does so. Even in late

June, the surface temperature of the southern North Sea is only about 11 degrees so across the southern North Sea in this example we have a good easterly flow, which is gaining moisture from the sea and also being cooled by it. But is there a temperature inversion to favour the formation of low, stratiform cloud, or stratus? Two sites in England from which radiosonde soundings are made are marked on the surface pressure chart. They are at Hemsby, about 1km inland just north of Great Yarmouth on the east coast (marked H) and Aughton (A), north of Liverpool on the west coast.

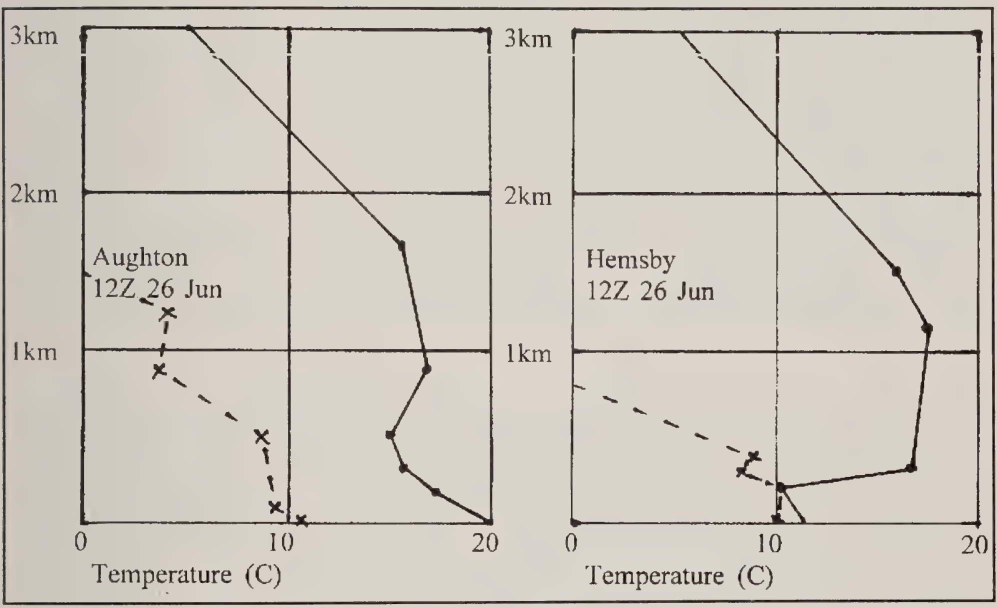
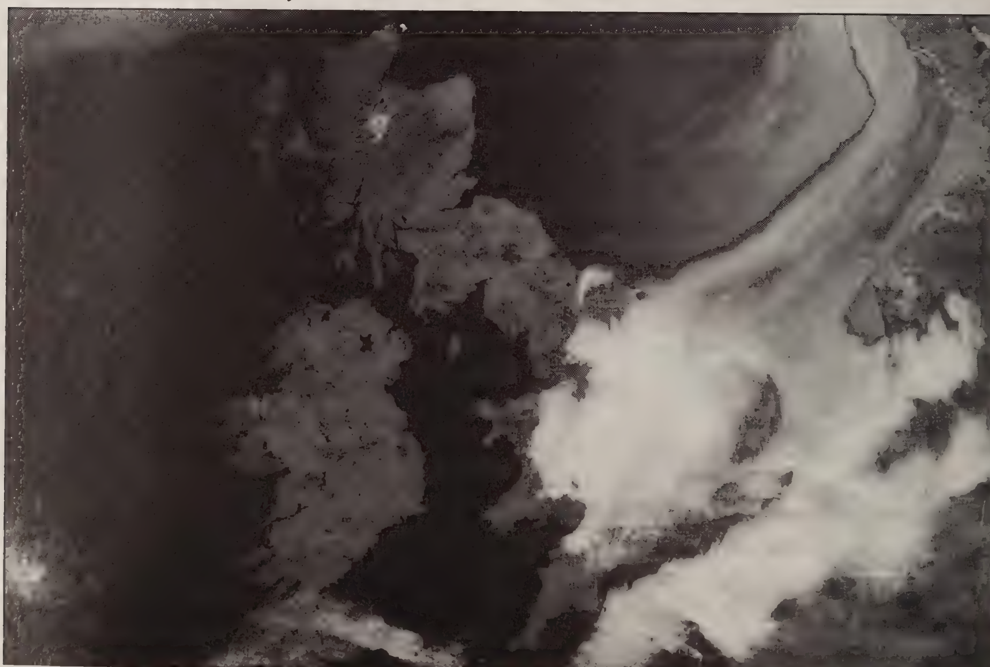


Figure 2

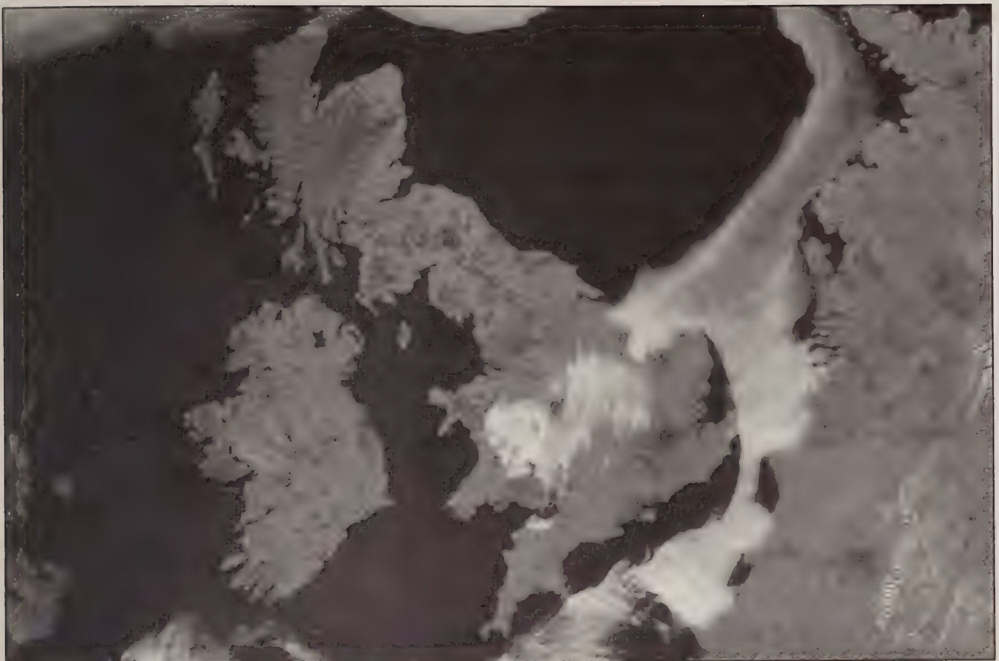
Figure 2 shows the temperature records from the radiosondes released from these two sites at about 1115UT on 26 June. The solid line represents the temperature whilst the broken line indicates the dewpoint. The Hemsby report shows a surface temperature of 11C (hardly surprising as the wind has come over a sea surface at that temperature) and a dewpoint only slightly lower, so the RH was high. The temperature fell a degree within 150m or so and the dewpoint was the same (ie the RH was 100%). Then in the next 100m or so the temperature rose to about 17C and the RH plummeted. This is a text-book example of a stratus situation.

The four images are from HRPT channel 2 and the first was from NOAA 10 at 0727UT, more than 3 hours after sunrise. A persistent easterly wind overnight had resulted in turbulent mixing of the near-surface cooling layer and a radio-

NOAA 10 0727UT 26 June 1995



NOAA 12 0832UT 26 June 1995



NOAA 9 1110UT 26 June 1995

NOAA 14 1257UT 26 June 1995

sonde released from almost anywhere in England at dawn would probably have shown a very similar temperature profile to the one from Hemsby shown in figure 2. The hills of southern England are not very high but sufficient to affect the distribution of low cloud and some of the variations in brightness of the cloud over land will be due to topographical effects.

At the edges of the cloud and where the layer is thinnest, sunlight can reach the ground and start to warm it up. This in turn warms the surface layer of air and reduces its relative humidity allowing some of the cloud droplets to evaporate, thus permitting even more sunlight to reach the surface. When once the sunshine penetrates the cloud and starts the dispersal process, the clearance of large areas of low cloud or fog can be very rapid. Nearer to the windward coast the warmed air will be replaced by cool air from the sea so along the coastal fringe the cloud may persist throughout the day.

By the time NOAA 12 came around an hour later, the southernmost counties of England were largely clear and a large hole had developed in the cloud to the northeast of London. By 1110UT, when NOAA 9 passed over, Wimbledon and the whole southeast were enjoying clear skies but low cloud persisted on the coast of East Anglia. Two rather stubborn patches persisted over the Midlands and east Wales. By 1257UT, when NOAA 14 transited from the opposite direction, only the coastal fringes of Norfolk were enveloped in cloud.

Comparing the two temperature profiles it is apparent that significant differences occur only in the lowest few hundred metres. Note that the dewpoint of the air at Aughton, even after blowing right across the country, is almost the same as at Hemsby. To change dewpoint, water has to be added or removed. Had the cloud been thick enough for drizzle to fall to the ground, then Aughton's dewpoint would have been lower.

Finally, there are a few other points about the images I would like to comment on. The second image in the sequence exhibits marked sun-glint towards Denmark and Holland which dramatically changes the appearance of the cloud layer. Note too how the southward movement of the northern edge of the cloud over the North Sea ties in with the northerly winds shown on the surface pressure chart. Presumably, slightly drier air is being advected southwards and is not being cooled sufficiently to form cloud. Moister air follows in turn with another cloudy area moving south off Scotland in the last two images. The Frisian Islands create an interesting effect too. The islands are very low-lying so obviously do not create a barrier to the southward-moving cloud yet the cloud disperses on the south side of the island chain. This must be caused by the sea temperature being higher due to the shallow water and reduced currents and tidal flow. ⊕

WEATHER SATELLITE RECEPTION USING THE ICOM R7100

AC Hewat

The ICOM R7100 is a VHF UHF receiver covering from 30MHz to 1999MHz and is equipped with a range of demodulators and IF filters. Having had one of these receivers for several years I decided that I would use it for weather satellite reception. However, for weather satellite use the factory installed IF filters and demodulators not optimal. Not wishing to change the internal IF filters I decided that there had to be another way. The R7100 is fitted with a wideband 10.7MHz IF output and an external IF strip seemed to be the best solution. Things are never that simple but, after some thought, a reasonably simple design was produced which is based on the IF design used in the VHF receiver by Ray Godden detailed in RIG 35, December 1993.

System Outline

Although this article is about how to use the IC-R7100 for the receiver I thought it might be useful to outline the full system. There are several ways a system based on the IC-R7100 could be configured and with the addition of an antenna changeover switch or relay could be used on both weather satellite bands. The system detailed here is shown in Figure 1. As the ICOM receiver is located indoors, sufficient gain must be available from the preamplifier located at the antenna or dish to overcome the feeder loss. The RIG HEMT preamplifier mounted on a 1m dish with some 40m of RG213 gives an acceptable quality signal. The

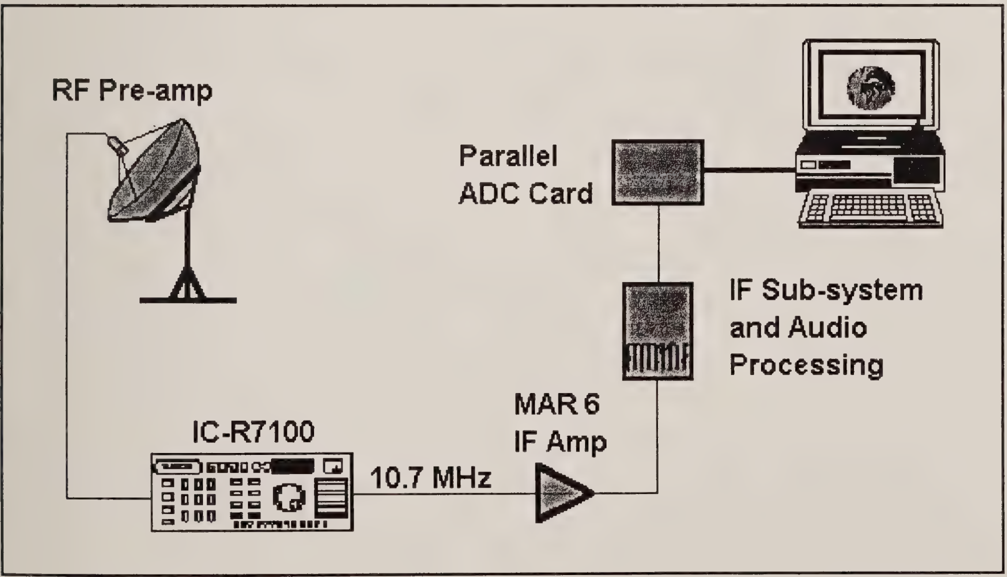


Figure 1. System Outline

10.7MHz output from the IC-R7100 is at approximately the same level as the receiver's RF input and thus needs amplification before the IF subsystem. The IF output of the IC-R7100 has approximately 9V available for powering an external IF amp and this technique has been used in the design. Care should be exercised with this output as the 9V supply is not protected from the internal supply rail and thus damage could be caused to the receiver if power is inadvertently fed into the IF connector or the output short-circuited.

The demodulator uses the CA3189, a single conversion IF sub-system The audio from this IC is band limited, further demodulated and then converted to 'PC Format' by an 8-bit A to D before being fed into the PC via a purpose-built parallel port. For convenience, and to allow for experimentation, the various parts of the system were made up as independent modules and interconnected by 75 ohm subminiature coaxial cable.

IF Stage

The IF filtering and demodulation is a direct copy from Ray Godden's December 1993 article. To provide the correct impedance match to the filter the original mixer transistor has been retained and is used as a 10.7MHz buffer. The filter chosen will depend on whether the polar-orbiting or or geostationary satellites are your main interest. I have used the one available from RIG. This filter probably has too wide a bandwidth to be ideal for geostationary satellites but it works well.

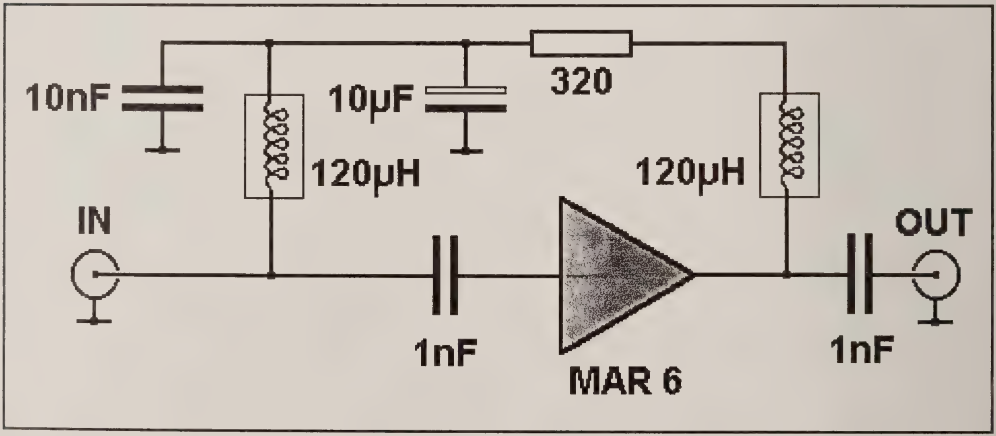


Figure 2. 10.7 MHz Amplifier

However, as stated above, an amplifier is required to increase the output from the IC-R7100. A simple way to do this is to use a monolithic amplifier. The MAR 6 was chosen as it has a high gain but any one of the series that is suitable for 10.7MHz

will suffice. Power for the MAR 6 is taken from the ICOM IF output socket and this has necessitated several extra components to separate the power from the IF signals. This part of the circuit is shown in Figure 2. It would be simpler to power the MAR 6 from the external demodulator's power supply as the MAR 6 requires power to be fed into the output pin of the device. However, as I require the MAR 6 amplifier to be independent and thus useful for another project, I have used the system detailed above.

LF Output & Computer Interface

As the demodulator is described in Ray Godden's original article I shall not repeat it here though the circuit diagram is shown in Figure 3. As I use JV Fax as the display system and have constructed the AF processing as in the notes accompanying the JV Fax programme I have thus omitted the AF processing detailed in Ray Godden's article.

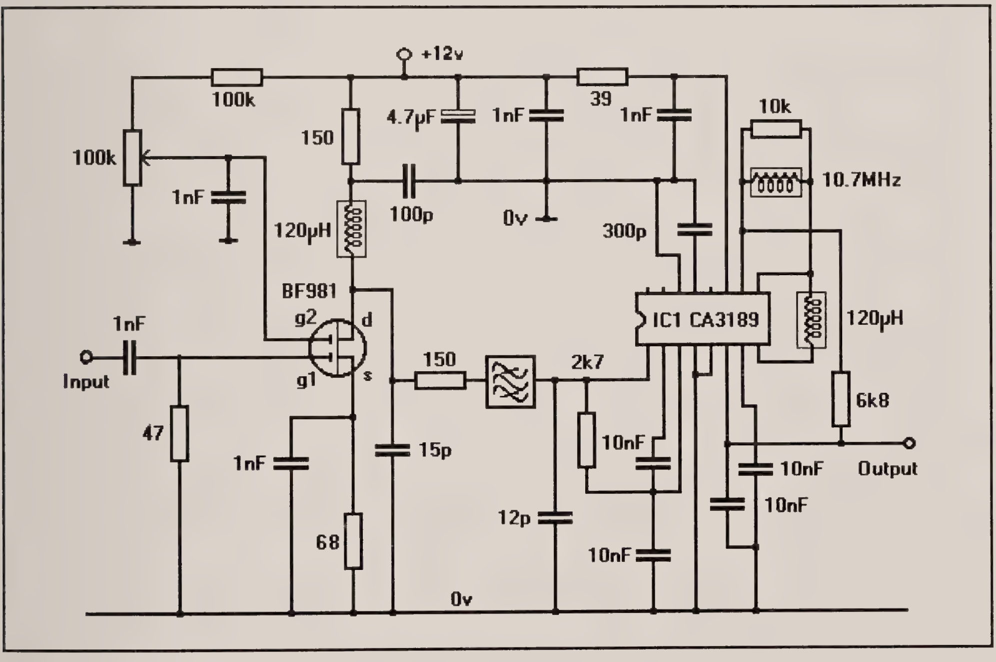


Figure 3. Demodulator

Construction

Although relatively straight forward to construct, here are some notes which may be helpful. My first attempt at producing an external demodulator based on the original article would not work and, after much experimentation, I almost gave up. After a discussion with Ray, he kindly sent me his prototype. With a little modification this worked and after detailed investigation I found that the crystal

filter in my version was open-circuit. Because of the high gain of the demodulator chip, some signals were being demodulated giving the impression that it was working but with very poor results!

The buffer FET used in this design is a BF981 but any HF device would do. The quadrature coil, between pins 9 and 10 of the IC, is a Toko KACSK586HM. The inductors used for the DC feed should be chosen with a self-resonance close to 10.7MHz. A printed circuit board has not been produced; the construction being done on single-sided board, which is used as an earth plane, with wire links between components.

For those of you who wish to experiment with other radios and this external IF and demodulator, the demodulator will produce acceptable results with a 10.7MHz input of 5 microvolts from the ICOM, therefore care should be exercised in the construction to ensure adequate screening and a logical layout. ⊕

GEAR PROBLEMS SOLVED

Graham Smith G1JVZ

In RIG 25 I wrote a short article on where to buy and how to use gears to make or modify fax printers and requested information on any other sources. There was no response but later I learned of HPC Gears Ltd at Chesterfield. I got their free catalogue and hardly put it down all week as it opened up new possibilities for repairing photocopiers, computer printers, aerial rotators and of course, fax printers. This year's edition has over 700 pages and is packed with information on every sort of gear you can think of as well as toothed belts and pulleys, sprockets, chains etc. The catalogue is pocket-sized and well laid out and the wealth of technical information makes it a great little reference book for model engineers.

Gears are available in many materials including steel, brass, tufnol and nylon. For a modest price, on gears they supply, HPC will cut keyways, tap holes and make bores to your specification. There's a breakdown service where the price for a new gear can be quoted or a new gear made just by sending in the parts of an old broken gear. Or if you have a gear and can't identify it, and need one to match it, you can send yours in to be inspected.

Free catalogue from: HPC Gears Ltd, Storforth Lane Trading Estate, Chesterfield, S41 0QZ. Telephone 01246 209683, fax 01246 205795. European office: Engrenages HPC S.A.R.L., 4 Allee de la Combe, Le Bois Dieu, 69380 Lissieu, Lyon, France. Telephone 78 47 01 05, fax 78 47 00 73. ⊕

F1A1A HRPT DEMODULATOR - NEW VERSION

Jean-Claude Beneche F1A1A

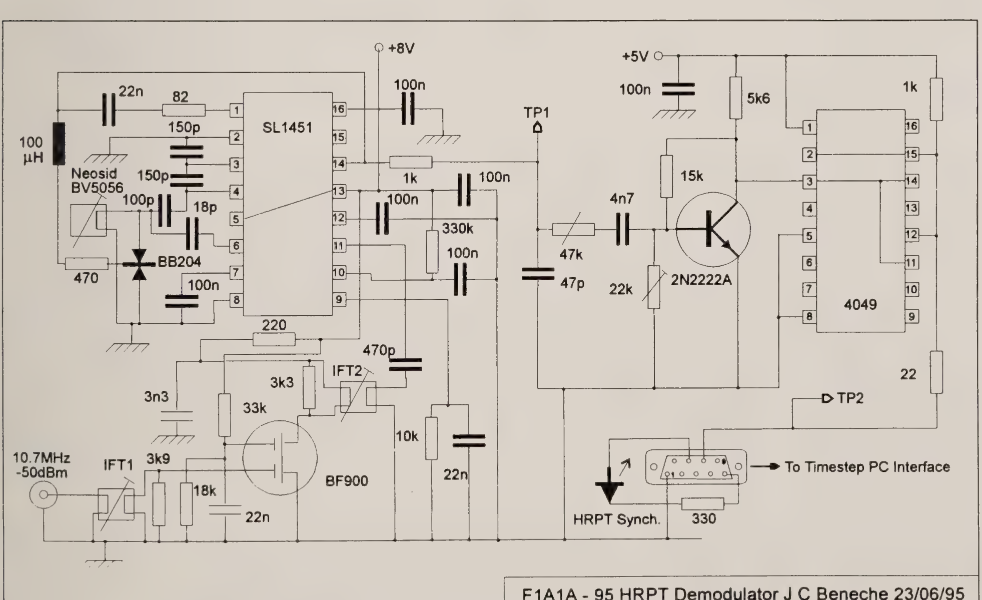
During the past year many readers have made this demodulator and some have found it difficult to obtain good results. I have modified the original design to improve reliability and to avoid parasitic oscillations, thus giving consistent good performance.

Construction

One thing is very important: the PCB *must* be double-sided. Remember that the SL1451 is designed to operate in the range 400 - 650MHz! Also, the SL1451 must be mounted directly to the PCB, without a socket.

Setting up the system

Present at pin 6 of the SL1451 should be a 1V rms 10.7 MHz oscillation. Adjust the Neosid core to obtain between 5V and 6V at pin 14 when a 10.7MHz signal is present at the demodulator input (use an HF generator). Finally, with an HRPT signal present, adjust the 47K and 22K variable resistors to obtain a good symmetrical signal at TP2 (output) at a frequency of 665.4 kilobits/second. If the Timestep interface is connected the LED should light indicating HRPT synchronisation. ⊕



A PRACTICAL BEGINNERS' GUIDE (2)

Humphrey Berridge

Once you are receiving good images from NOAA14, say, where do you go next?

POLAR-ORBITERS

You will probably have identified some key geographical features. Most people quickly spot Italy and Gibraltar and you may now be familiar with the curious shape of Iceland, picked out the Greenland coast, the Baltic, the Mediterranean islands and the Gulf of Sirte. Obviously, try getting other NOAA satellites and experiment with both visible and infra red (IR) scans. Monitor both 137.62 and 137.50 MHz. Infra red images can be low in contrast but, at some times of the year, they can be impressive and particularly interesting when compared directly with their visible counterpart. It is quite easy to spot that the phasing lines on the edge of the image are wider in front of a visible picture, and narrower in front of an IR one - these correspond to the tone-bursts of 300 and 450 Hz. Also, try getting images from the Meteor satellites (137.85 MHz is a good place to start), or the elusive OKEAN 4 (137.40 MHz); Meteors are in higher orbits than NOAAs so are in range for longer. They are easily distinguished by their wheel-barrow with a rusty wheel sound.

Printed images never look as good as those on a monitor but before printing you may like to try adjusting the contrast. This is easily done with the JVFAX software using histogram equalisation. It is quite a slow process but the result is a better print. Caution; this process over-writes your original image, so if it is a special one, make a copy on disc first! Another excellent feature of the JVFAX software is its ability to record record images whilst you are out shopping or at work.

If you feel that you want to enhance your receiver, you could add a signal strength meter. Although not essential, there are rewards in comparing the signal your hear and the strength on the meter with the quality of the received pictures and in comparing the strengths from different satellites. Furthermore, you will be able to watch the signal strength pulsating as the satellite rises and sets due to an interference effect of the radio waves when the satellite is very low in the sky. Hint: The Dartcom receiver from the RIG Shop has a connection for an S-meter but no information about what to connect. For a good strong signal, about 7 or 8 volts is produced: I used a cheap 0 - 100 μA meter (you can also get them with small bulbs to fit in the back to illuminate the meter screen and act as a power-on indicator) in series with a 68k resistor.

Finally, a lot can be learnt from a good graphical prediction program which can display the orbital positions of several satellites simultaneously, either in real time or speeded up. Several, including Bird Dog 3.0, are available from the RIG

shareware library. These programs require good data and you will need to update the orbital information on a regular basis using Twoline Kepler elements such as those given in the Journal or downloaded from a bulletin board. Keep the list of satellites displayed short to keep the screen uncluttered.

METEOSAT

If you want to develop your system further, you may want to add the facilities of the geo-synchronous satellite, Meteosat. It is located in a fixed position over the equator, and transmits processed images every four minutes, 24 hours every day (see Peter Wakelin's articles 'The Meteosat System' in issues 39 and 40). Its transmission is on microwave, rather than VHF frequencies, and it is very weak, Meteosat being much further away than the polar-orbiters, in fact about 36,000km above the equator.

Fortunately, only two additional pieces of hardware are needed; they are a dish aerial with feed and a down-converter. The latter takes in the microwave frequency (1691.0 or 1694.5 MHz), and amplifies and converts it to a VHF frequency which is normally 137.50 MHz (Figure 1). The JVFAX software contains all that is necessary to decode Meteosat images.

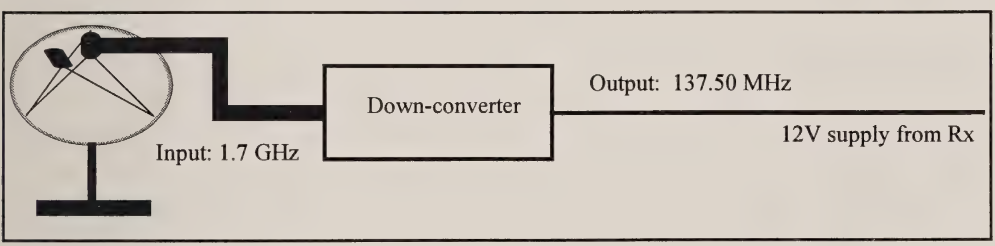


Figure 1

Hardware for Meteosat Reception

The first requirement is a good 'view' from your location to the south, and at quite a low angle (from the UK). Signals from Meteosat are considerably weaker than those from Sky Astra TV satellites and therefore, to get a good clean signal, we need a larger dish. TV satellite dishes are usually about 60cm in diameter but the minimum recommended size for Meteosat is 1m. Also, given the problems with the satellite's own aerials (reported in previous Journals), if you can get hold of a 1.3m dish, so much the better. It is the area of the dish that matters in terms of signal capture, so a 1m dish is nearly 3 times the area of a 60cm dish, and a 1.3m dish gives a further increase in area of about 70%.

If for any reason a large dish is impossible at your location, or if you have a poor site screened by dense trees, it is possible to add a 1.7 GHz low noise amplifier (LNA) between the dish feed and the down-converter. However these are not

cheap and do not produce a cost-effective solution to the problem. Point the dish towards Meteosat, which from Britain lies in the south at 30 degrees elevation from Southern England and about 20 degrees from Scotland. A compass is one way to determine south but if the sun is shining, use the shadow of the feed at noon (12 in the winter, but 1pm during BST) to get approximate alignment. Leave the nuts and bolts finger-tight at this stage so that the aerial does not slip but can be moved in its mounting by hand.

The down-converter is mounted in a waterproof box, and must be as close to the dish as possible. At microwave frequencies, coaxial cables create a significant amount of loss, and we do not have much signal to start with. The feed on the dish should be connected to the down-converter by N-plugs and thick RG67 cable, preferably no more than a metre or two long. The output from the box is then connected to your receiver via a normal piece of high-quality 50 ohm coaxial cable: this both carries the signal and a 12V supply (see later) from the receiver to power the down-converter, in just the same way as the VHF pre-amp on your polar-orbiter aerial. The cable from down-converter to receiver can be quite long, 100m or so.

For alignment purposes, the best thing is to make an extra short lead so that you can take your receiver outside near the dish, perhaps by putting the receiver on a convenient window sill - the crucial thing is to be able to hear the loudspeaker whilst manipulating the dish. Tune the receiver to 137.50 MHz and with luck you will hear APT noises. Now it is simply a question of gently moving the dish to get the best possible signal - this is best done by listening for minimum background noise and clear pings. The bigger the dish, the narrower the beamwidth, so the more crucial is accurate positioning. Once the position is OK, try moving the feed slightly in and out to tweak the most out of your aerial, and check that the active element of the feed is horizontal (assuming you are not too far from the Greenwich Meridian).

Once you are satisfied that you are getting a good signal, tighten all the bolts on the dish, and if it is not fastened to the ground, mark its position by, say, discrete scratches on the patio - dishes can move around in the gales! Then tape over the external connections to the dish feed and the down-converter. The best thing to use is self-amalgamating tape, but it is difficult stuff to get off again: PVC tape tightly wound is also good. This is especially important on BNC type connectors which are not water-tight. The ingress of water is the most common cause of poor performance.

JVFAX Software for Meteosat Reception

On JVFAX, select 'Fax', and then change mode for Meteosat Channel 1 (Mode 3). This works just as before and at the start of each image, the software should display the image correctly synchronised. You can also save it by pressing <F3> be-

PREDICTED TIMES FOR AQUISITION OF SIGNAL FOR 52.5 DEG NORTH, ZERO DEG EAST

	NOAA 9				NOAA 12				NOAA 14				OKEAN 4			
	Period 101.91 mins				Period 101.28 mins				Period 102.07 mins				Period 97.75 mins			
	137.62MHz				137.50MHz				137.62MHz				137.40MHz			
	S'bound		N'bound		S'bound		N'bound		S'bound		N'bound		S'bound		N'bound	
10 Sep	0939	1120	1931	2111	0733	0913	1721	1901	0101	0241	1234	1415	0827	1005	2110	2247
11	0927	1107	1918	2058	0710	0852	1700	1839	0050	0230	1223	1404	0715	0853	2135	2313
12	0914	1154	1906	2045	0650	0829	1640	1817	0219	0401	1212	1353	0741	0919	2201	2341
13	0901	1041	2032	2214	0628	0807	1755	1936	0208	0350	1201	1342	0809	0946	2051	2228
14	0850	1029	2019	2200	0746	0926	1734	1914	0157	0339	1150	1331	0656	0834	2116	2255
15	1016	1156	2006	2147	0723	0905	1712	1852	0147	0328	1140	1320	0723	0900	2143	2324
16	1001	1142	1953	2134	0702	0842	1650	1830	0137	0317	1129	1310	0751	0928	2034	2209
17	0949	1130	1940	2121	0641	0821	1808	1950	0126	0307	1118	1259	0637	0815	2057	2236
18	0937	1117	1928	2107	0620	0759	1747	1927	0115	0255	1108	1248	0704	0842	2125	2306
19	0924	1104	1915	2055	0737	0918	1725	1905	0104	0244	1237	1418	0731	0909	2014	2150
20	0911	1051	1903	2042	1715	0856	1703	1843	0053	0234	1226	1407	0619	0756	2038	2220
21	0857	1037	2028	2209	0654	0834	1642	1821	0222	0404	1215	1356	0646	0823	2106	2247
22	0846	1025	2015	2156	0633	0812	1759	1941	0212	0354	1204	1346	0533	0712	1955	2132
23	1011	1152	2002	2143	0750	0931	1737	1918	0202	0342	1154	1335	0601	0738	2019	2159
24	0958	1139	1950	2130	0728	0909	1715	1855	0150	0331	1143	1323	0627	0805	2047	2228
25	0945	1126	1936	2117	0707	0847	1654	1834	0140	0321	1132	1313	0654	0832	1934	2113
26	0933	1114	1924	2104	0645	0825	1634	1812	0129	0310	1122	1302	0542	0719	1826	2001
27	0920	1100	1912	2051	0623	0803	1751	1932	0118	0259	1111	1251	0608	0746	1851	2027
28	0906	1047	2037	2219	0742	0922	1729	1909	0108	0248	1240	1422	0456	0635	1916	2054
29	0854	1034	2025	2206	0719	0900	1708	1847	0057	0237	1229	1411	0523	0701	1807	1942
30	1021	1202	2012	2153	0659	0838	1646	1825	0226	0408	1219	1359	0550	0728	1833	2009
01 Oct	1008	1149	1959	2140	0636	0816	1804	1947	0215	0357	1207	1349	0437	0616	1859	2036

	NOAA 9				NOAA 12				NOAA 14				OKEAN 4			
	S'bound		N'bound		S'bound		N'bound		S'bound		N'bound		S'bound		N'bound	
02 Oct	0954	1136	1946	2127	0615	0754	1742	1923	0204	0346	1157	1338	0504	0642	1924	2103
03	0941	1122	1934	2114	0733	0913	1720	1900	0154	0335	1146	1327	0531	0709	1813	1950
04	0929	1109	1920	2100	0710	0851	1659	1839	0143	0324	1135	1316	0418	0558	1840	2017
05	0916	1057	1908	2047	0650	0829	1638	1816	0132	0313	1125	1305	0446	0623	1906	2044
06	0903	1043	1856	2035	0627	0807	1755	1936	0122	0302	1114	1254	0514	0650	1755	1931
07	0850	1030	2021	2203	0745	0926	1733	1914	0111	0251	1243	1425	0400	0538	1820	1958
08	1017	1159	2009	2149	0723	0905	1712	1852	0100	0240	1232	1414	0426	0604	1846	2027
09	1004	1145	1956	2137	0703	0842	1650	1830	0229	0411	1222	1404	0315	0453	1736	1913
10	0951	1132	1943	2123	0641	0821	1630	1808	0218	0400	1211	1352	0342	0520	1626	1801
11	0939	1119	1930	2110	0620	0759	1746	1927	0207	0349	1200	1341	0408	0546	1653	1828
12	0925	1106	1917	2057	0737	0918	1724	1905	0157	0338	1150	1330	0256	0435	1718	1855
13	0913	1053	1905	2044	0714	0855	1703	1843	0145	0327	1139	1319	0323	0500	1742	1921
14	0859	1040	1853	2031	0653	0833	1642	1821	0136	0316	1128	1308	0349	0527	1633	1808
15	1027	1208	2018	2159	0631	0812	1759	1940	0124	0306	1118	1257	0240	0416	1658	1835
16	1014	1155	2005	2146	0750	0930	1738	1918	0114	0255	1247	1429	0304	0443	1549	1723
17	1001	1141	1952	2133	0728	0909	1716	1857	0103	0243	1235	1417	0331	0508	1616	1750
18	0948	1128	1939	2119	0707	0847	1654	1834	0053	0232	1225	1407	0218	0356	1641	1817
19	0935	1115	1926	2107	0645	0825	1632	1812	0222	0403	1215	1355	0246	0424	1530	1706
20	0922	1103	1914	2053	0623	0803	1750	1931	0211	0352	1203	1344	0313	0449	1556	1732
21	0910	1049	1900	2040	0740	0921	1728	1909	0200	0341	1153	1334	0159	0338	1621	1758
22	0855	1037	2028	2209	0719	0900	1708	1847	0150	0330	1142	1323	0226	0405	1511	1646
23	1023	1205	2014	2156	0658	0838	1646	1825	0139	0319	1131	1311	0254	0432	1538	1712
24	1010	1151	2001	2142	0636	0816	1804	1944	0128	0309	1121	1301	0141	0320	1602	1739
25	0957	1138	1949	2129	0615	0754	1742	1922	0117	0258	1111	1250	0208	0346	1452	1627
26	0945	1125	1936	2116	0732	0913	1720	1900	0107	0247	1239	1421	0235	0412	1519	1654
27	0932	1112	1923	2103	0711	0850	1659	1838	0056	0236	1228	1410	0122	0301	1544	1721

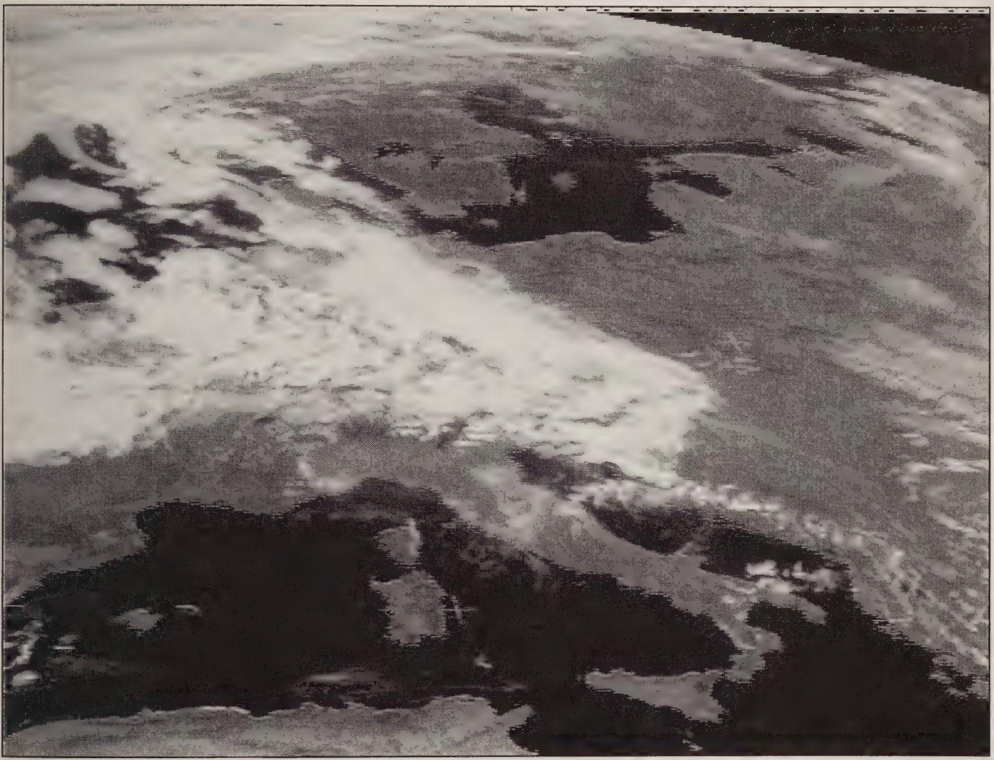
	NOAA 9				NOAA 12				NOAA 14				OKEAN 4			
	S'bound		N'bound		S'bound		N'bound		S'bound		N'bound		S'bound		N'bound	
28 Oct	0919	1059	1910	2049	0649	0829	1638	1816	0225	0406	1218	1358	0149	0327	1609	1748
29	0904	1046	1858	2037	0628	0807	1754	1935	0214	0356	1207	1348	0039	0216	1458	1635
30	0852	1033	2024	2205	0746	0926	1733	1913	0203	0344	1156	1337	0105	0243	1525	1702
31	1020	1201	2011	2142	0723	0904	1712	1851	0153	0334	1145	1326	0129	0308	1551	1731
01 Nov	1006	1147	1958	2139	0702	0842	1650	1829	0142	0323	1134	1315	0158	0335	1439	1616
02	0954	1135	1945	2126	0640	0820	1807	1949	0132	0312	1124	1304	0045	0224	1504	1644
03	0941	1122	1933	2112	0619	0758	1746	1927	0121	0301	1113	1253	0112	0249	1531	1713
04	0929	1108	1920	2059	0735	0917	1724	1905	0109	0250	1243	1424	0000	0139	1421	1558
05	0916	1055	1907	2046	0714	0855	1702	1842	0059	0240	1231	1413	0027	0205	1446	1625
06	0902	1042	1855	2033	0654	0833	1641	1821	0048	0228	1221	1402	0054	2341	1513	1653
07	1029	1210	2021	2202	0630	0811	1759	1940	0217	0359	1210	1351	0121	0257	1404	1539
08	1016	1158	2008	2149	0749	0930	1737	1917	0206	0348	1159	1340	0008	0148	1427	1606
09	1003	1144	1955	2135	0727	0908	1715	1856	0156	0337	1149	1330	0034	2322	1454	1636
10	0950	1131	1942	2122	0706	0846	1654	1834	0145	0326	1138	1318	0100	2348	1343	1520
11	0937	1118	1929	2109	0644	0824	1633	1812	0135	0315	1127	1308	2238	2416	1408	1549
12	0925	1105	1916	2056	0623	0802	1750	1930	0124	0304	1117	1257	2303	2443	1259	1435
13	0912	1052	1904	2043	0740	0921	1729	1909	0112	0253	1246	1428	2330	2507	1324	1502
14	0858	1039	2030	2211	0718	0859	1707	1846	0102	0242	1235	1416	2220	2358	1215	1351
15	1026	1207	2017	2158	0657	0838	1645	1825	0052	0232	1224	1405	2246	2422	1241	1417
16	1013	1154	2004	2145	0635	0815	1803	1944	0221	0402	1213	1354	2312	2449	1307	1443
17	0959	1140	1951	2132	0754	0933	1741	1922	0210	0352	1203	1343	2129	2338	1156	1331
18	0946	1127	1939	2119	0732	0912	1719	1859	0200	0340	1152	1332	2226	2404	1222	1357
19	0934	1114	1925	2105	0710	0851	1658	1838	0149	0329	1141	1321	2252	2431	1247	1424
20	0921	1101	1913	2052	0648	0828	1637	1816	0138	0318	1130	1310	2140	2319	1136	1312
21	0908	1048	2039	2221	0626	0806	1754	1935	0127	0308	1120	1300	2207	2345	1203	1339
22	1035	1216	2026	2208	0745	0925	1733	1913	0116	0257	1109	1249	2223	2412	1229	1405

	NOAA 9				NOAA 12				NOAA 14				OKEAN 4			
	S'bound		N'bound		S'bound		N'bound		S'bound		N'bound		S'bound		N'bound	
23 Nov	1022	1203	2014	2154	0723	0903	1711	1851	0105	0245	1238	1419	2300	2439	1253	1434
24	1009	1150	2000	2141	0702	0841	1649	1829	0054	0235	1227	1408	2148	2326	1143	1320
25	0957	1137	1948	2129	0640	0820	1807	1948	0223	0405	1216	1357	2214	2352	1211	1347
26	0944	1124	1934	2115	0619	0758	1745	1926	0213	0355	1205	1347	2104	2242	1235	1415
27	0931	1111	1922	2102	0737	0917	1723	1904	0202	0343	1155	1335	2130	2308	1124	1301
28	0915	1057	1909	2049	0714	0854	1702	1841	0152	0333	1144	1324	2156	2333	1150	1328
29	0903	1044	2036	2217	0653	0832	1641	1820	0141	0322	1134	1314	2044	2223	1216	1357
30	1031	1213	2023	2204	0631	0810	1758	1939	0130	0311	1123	1303	2111	2248	1105	1242
01 Dec	1018	1159	2010	2151	0610	0749	1737	1917	0119	0300	1112	1252	2137	2315	1130	1309
02	1005	1146	1957	2137	0728	0907	1715	1855	0108	0249	1241	1423	2025	2203	1158	1338
03	0952	1134	1944	2124	0705	0845	1655	1833	0058	0238	1230	1412	2052	2229	1048	1224
04	0940	1121	1931	2112	0644	0824	1633	1811	0227	0409	1220	1401	2119	2257	1111	1250
05	0927	1107	1918	2058	0622	0801	1749	1930	0216	0358	1208	1350	2007	2145	1003	1138
06	0914	1054	1907	2045	0739	0920	1728	1908	0205	0347	1158	1339	2033	2211	1029	1205
07	0901	1041	2032	2213	0718	0859	1706	1846	0155	0336	1147	1328	2100	2238	0918	1054
08	1028	1209	2020	2200	0656	0837	1644	1824	0143	0326	1137	1317	1948	2127	0944	1121
09	1014	1156	2006	2148	0635	0815	1802	1943	0133	0315	1126	1306	2015	2152	1009	1147
10	1003	1143	1953	2134	0613	0753	1741	1921	0122	0303	1115	1255	2042	2219	0900	1034
11	0949	1130	1941	2121	0731	0911	1719	1859	0111	0252	1105	1244	1929	2106	0926	1102
12	0937	1116	1928	2107	0710	0850	1657	1837	0101	0241	1234	1415	1956	2133	0950	1128
13	0923	1104	1915	2054	0648	0827	1636	1815	0050	0231	1223	1404	2022	2201	0840	1015
14	0910	1051	2041	2223	0626	0806	1753	1934	0219	0401	1212	1353	1910	2048	0907	1042
15	0857	1037	2029	2210	0745	0925	1732	1912	0209	0350	1201	1342	1937	2115	0931	1109
16	1024	1205	2015	2157	0723	0902	1710	1850	0157	0339	1150	1331	2004	2142	0956	1137
17	1011	1152	2002	2143	0701	0840	1649	1828	0147	0328	1140	1320	1852	2032	0846	1023
18	0958	1140	1950	2130	0640	0819	1628	1806	0137	0317	1129	1310	1918	2056	0914	1049

fore the image starts.

I find it a fiddle to get the image to start and end automatically and, when I do, I cannot display the full contrast range being received. If anyone has some neat way of doing this, I would be very glad to hear from them. To get reliable triggering of the image start and end, I need the histogram display to only go about two thirds of the way up, and not to reach peak white as suggested.

The images of most interest in the UK are the infra red D2 (at 30 and 58 minutes past each hour) covering our section of the globe, and visible light C02 and C03 (at 2, 34, 6, 38 minutes past the hour respectively during the day time); the latter ones are close-up images of Europe, divided down the Greenwich Meridian. A Meteosat schedule was published in RIG Journal No. 39, December '94.



An example of the C03 format.

As mentioned above, the down-converter is normally powered by a 12V supply up the aerial lead. However, the Martelec MSC30 down-converter uses this supply to switch between the two channels from Meteosat. If the voltage is above a certain value you get Channel 2, and if below that value, you get Channel 1 (the

switching voltage is about 14V, and can be changed by a small multi-turn trimmer resistor inside the box anywhere from 12 to 15V). In the next issue I will give details of how this can be operated under software control.

The JVFAX software allows plenty of scope with Meteosat images, notably receiving them automatically and making movies. It is also possible to add coloured masks to land and sea to give very pretty images indeed. For this to work, your computer's clock must be accurate; many are not. The trick is to get hold of some suitable software such as 'Clockwork' from the RIG shareware list, so that your clock is within a few seconds.

Having got some nice Meteosat images, it is natural to want to get the coloured masks added in. This is done by the software looking up a schedule of images so that it knows which mask to load before each one starts - hence the need for accurate timing. If the schedule is not correct, you get very odd looking pictures where the mask does not fit the coastlines. As stated in the JVFAX manual, the solution is to get automatically an updated schedule which the software can do by receiving images continuously for 24 hours. It is not possible to get coloured Meteosat images with standard VGA graphics. You need an SVGA mode with 256 colours (typically VESA 800 x 600 pixels and 256 colours) - this might be possible with your computer using suitable driver software but in my case I was moved to go any buy a new graphics card. The graphics setting needs to be set up from the configuration screen on the JVFAX software. Of course, the card will also improve the resolution of your polar-orbiting images, as well as your Windows software.

When you manage to receive Meteosat images with the correct masks, have a close look at a C03 image; you will see that because this picture gives the best view of Germany, Eberhard Backeshoff has included his own little logo to cheer us all up.

MUIRHEAD FAX EQUIPMENT

A number of K400 transmitters (both B and D type) and K401 receivers (B type to 500rpm) are available for £10 - just a tiny fraction of the original cost. Electrosensitive paper and spare parts are also available. Anyone contemplating building a photographic fax system for satellite image reception using the new, bright, blue LEDs could consider these machines as a source of suitable hardware.

For more information contact Graham Smith on 01623 662862.

A JVFAX SYNCHRONOUS AM INTERFACE

Greg Jameson

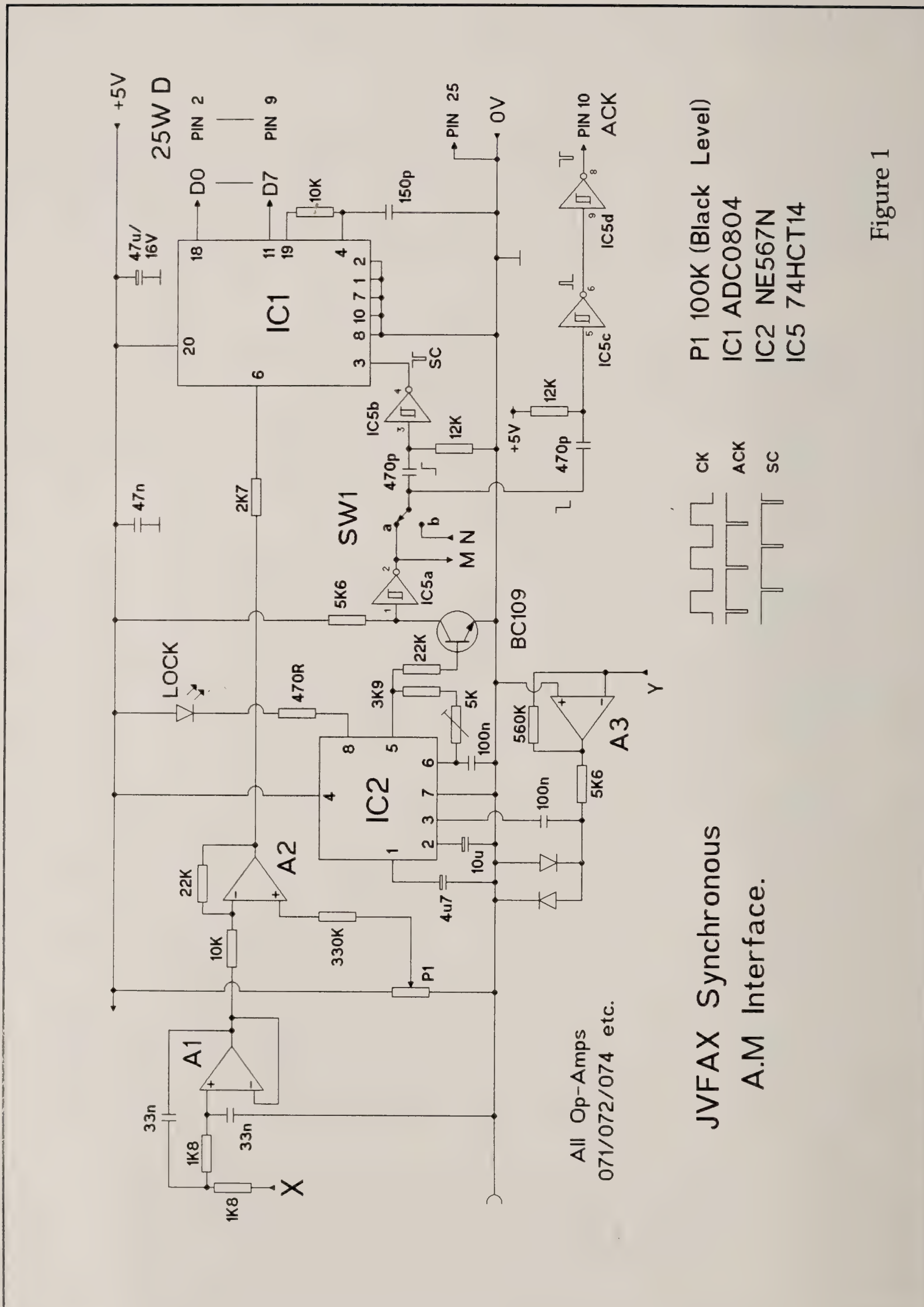
I had been plagued by computer-generated noise right from the start of my interest in weather satellite signal decoding. As I never solved this annoying problem to my total satisfaction, I considered the advantages of recording weather satellite signals and set to work on making an interface that would track the variations in the play-back speed of a cassette recorder which would otherwise ruin the reproduced image.

This circuit uses JVFAX set-up for BidPrintPortIRQ input (see JVFAX documentation for details). This means that you must have an LPT port which can be set-up/ modified for 8 bit input. In my case I originally used an old serial/parallel card with pin 1 of the 74LS374 output latch cut. You should be able to get one of these cards second hand from your local computer shop for a few pounds or alternatively you can now get new multi I/O cards that can be configured for bidirectional I/O, usually by just removing a jumper.

Referring to the circuit diagram, Figures 1 and 2, the A.M detector section is fairly typical and consists of an input amplifier and band-pass filter (A4 & A5). There follows a precision rectifier/low-pass filter (A6 & A7). Finally, further low-pass filtering and a level shifter (A1 & A2) precede the ADC (IC1). Note that before rectification, the signal is also amplified via A3 and fed to the first PLL (IC2) which locks onto the 2400Hz tone and provides indication that a steady lock has been achieved. A buffered 2400hz square wave appears at SW1 contact a. This signal is also fed into the second PLL IC3 and associated divider IC4 which act as a frequency doubler. So a 4800Hz signal appears at SW1 contact b.

SW1 selects either a 2400 or 4800Hz square wave and so changes the resolution (this signal will change in frequency to follow any variation in the recorded signal). This clock signal is then fed into a rising edge triggered monostable IC5b and a falling edge triggered monostable/invertor IC5c, d. The negative pulse that appears on the output of IC5b is used to start an A to D conversion (IC1 is an 8 bit ADC), and the negative pulse at IC5d output is used to tell JVFAX to read the output of the ADC. The timing of these pulses is such that the ADC will always have ample time to complete a conversion before its output is read by the program.

I built the circuit on stripboard and all the setting up that is required is to adjust the VCO of IC2 to around 2.4KHz. A frequency counter is ideal for this but you can do it by finding the middle of the range that the LED is on, with a signal connected to the input.



+5V
25W D
D0 — D7
PIN 2 — PIN 9
PIN 25
0V
PIN 10
ACK
47u/16V
IC1
20
18
11
19
6
3
8
10
7
1
2
4
10K
150p
SC
IC5b
IC5c
IC5d
12K
470p
+5V
SW1
a
b
M
N
5K6
IC5a
BC109
22K
3K9
5K
100n
560K
A3
Y
2K7
47n
LOCK
470R
IC2
8
5
6
7
3
2
1
4
10u
4u7
5K6
A2
22K
10K
330K
P1
A1
33n
1K8
X
CK
ACK
SC
P1 100K (Black Level)
IC1 ADC0804
IC2 NE567N
IC5 74HCT14
All Op-Amps
071/072/074 etc.
JVFAX Synchronous
A.M Interface.

Figure 1

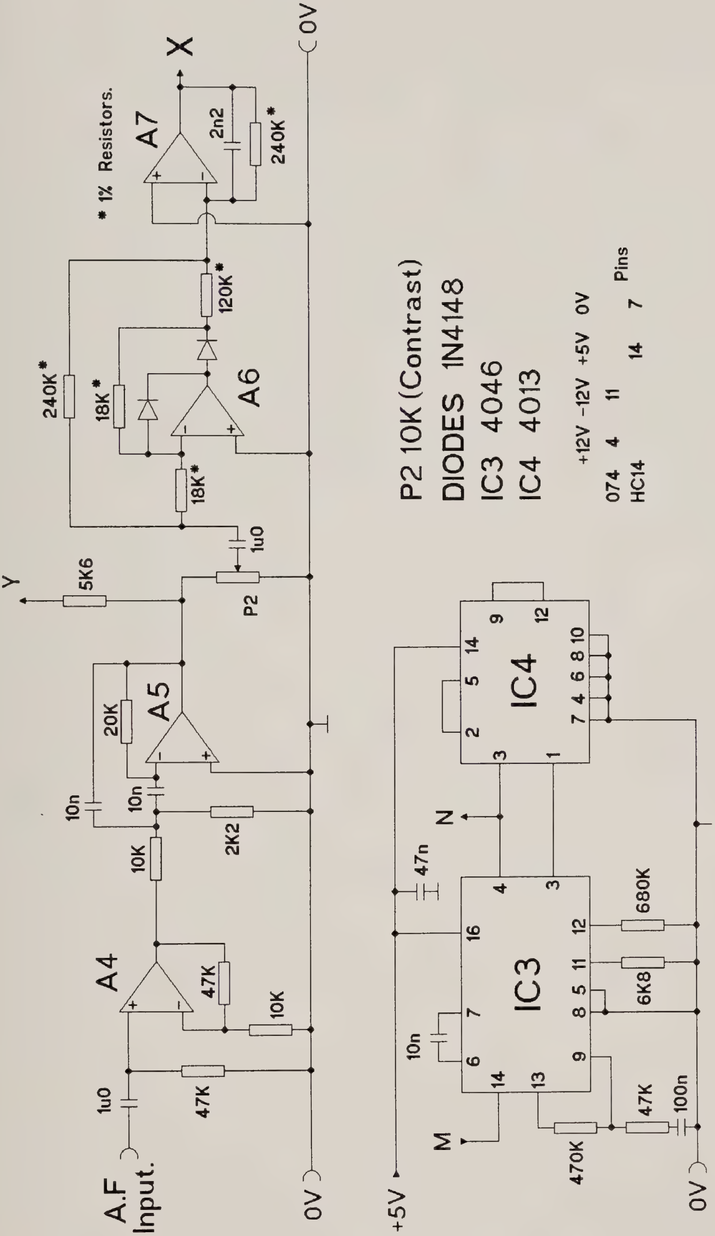

A.F. Input.
1u0
47K
A4
47K
10K
0V
10K
10n
10n
2K2
20K
A5
5K6
Y
P2
1u0
18K*
18K*
240K*
A6
120K*
* 1% Resistors.
A7
2n2
240K*
X
0V
P2 10K (Contrast)
DIODES 1N4148
IC3 4046
IC4 4013
+12V -12V +5V 0V
074 4 11
HC14 14 7
Pins
+5V
M
N
47n
10n
IC3
IC4
470K
47K
100n
6K8
680K
0V

Figure 2

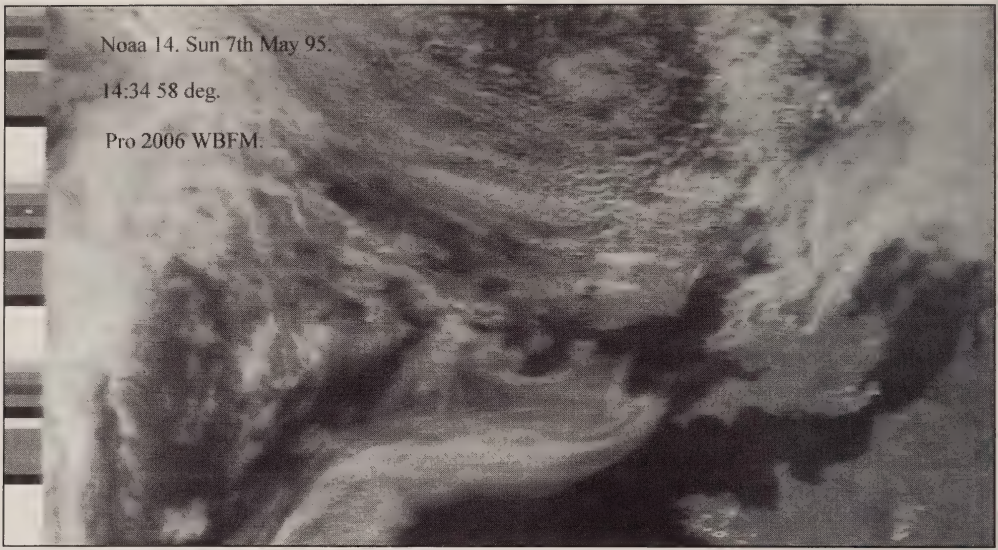


Figure 3

Note that this particular interface will also work with an I/O card (live reception only) such as the Maplin LP12N. If you want to try this then connect the 8 bits and 0V from the ADC0804 to port B and set up JVFAX for Parallel interface at address H301.

Figure 3 is part of a recent picture that I reproduced from a recording using the interface and as you can see the edge is quite straight! Finally, I'm sure that the circuit can be improved upon and so if you have any ideas or need further information then please write to me at: 65 Brynhyfryd St, Tonypandy, Mid Glamorgan, CF40 2DY, UK. ⊕

WANTED. TIMESTEP PROscan (version 4.0/4.1) receiver with PROsatII software and interface - all in good working order. A Sampson, North Walsham. 01692 402826.

FOR SALE. Professional DARTCOM APT polar and geostationary system for PCs comprising PC controlled receiver, DSP interface, cables and software (for WD chipset graphics but upgradeable to all cards and Windows). L/Sat disks. As new £395. Also 137 MHz masthead preamp (SSB-German) plus Dartcom h/duty turnstile aerial (loft use only) £75. All back issues of RIG magazine available enquire. Phone Paul G4XHF (day) 01622 696437. MUST SELL so offers for the lot!

FOR SALE. DARTCOM 137 MHz receiver, JVFAX decoder, cables, crossed dipole aerial. £160 + carriage. Trevor Worall, 01709 371694 after 6pm.

RIG CONFERENCE

This year's RIG conference was held in Guildford on Saturday 29 April. It proved to be a very popular event with about 230 members and guests attending; some from overseas. There were three parts to the day, the exhibition, the lectures and at the end of the day, the RIG AGM.

The exhibition area was very busy with 20 stands. There were the well known names supplying amateur and educational hardware and software for remote imaging. Many exhibitors were offering demonstrations of their latest equipment and software upgrades. It was also encouraging to have the support in the exhibition from some of our national agencies. The British National Space Centre, the National Remote Sensing Centre and the Space Division of the Defence Research Agency were all represented as were the Remote Sensing Society and Rutherford Appleton Laboratories.

Questions and Answers on the Everest Expedition. Photo: Richard Harcourt

The programme of speakers was excellent. There were illustrated talks on 'Synthetic Aperture Radar', 'Satellites and the Current Russian Scene', 'Remote Sensing and Agribusiness', 'Monitoring Coastal Processes', 'CCD Imaging on UoSATs' and 'Operating APT During the Mount Everest Meteorological Experiment 1991'. Our thanks must go to all the speakers for the excellence of their presentations.

From the feedback that I have had everybody was pleased with the day and the

balance of exhibition time and lectures was judged to be about right.

Next Year's Conference

Your committee are already discussing plans for a 1996 conference. Please let us have YOUR views about a 1996 conference so it can be planned to suit the maximum number of members. Where should it be located and should it be a one day event or a full weekend? In order not to disadvantage members in different parts of the country we are considering a venue other than the south east. Where should the next conference be held? Better still would you be prepared to help with its organisation? Where ever it is located we promise to make the 1996 event as successful as the 1995 conference. ⊕

GALILEO NEARS JUPITER

Peter Wakelin

The Galileo spacecraft was planned to fly directly to Jupiter after launch aboard a Space Shuttle in May 1986. A powerful upper stage rocket, Centaur, was due to boost it on its way after release from the Shuttle's cargo bay. After the Challenger accident early in 1986, the Centaur was considered to be too hazardous to carry on a manned space vehicle. A safer, but less powerful, upper stage called the Inertial Upper Stage was substituted. The IUS lacked the power to travel directly to Jupiter so mission designers devised a flight path that used the gravity fields of Venus and Earth to accelerate the spacecraft enough to reach Jupiter.

Launch eventually took place in October 1989 and after a gravity-assist swingby of Venus and two of Earth, it eventually headed for Jupiter. On 11 April 1991 the spacecraft executed stored commands to unfurl the large, high-gain antenna. Later telemetry indicated that the antenna failed to deploy correctly and subsequent attempts to correct the problem failed.

There is a less directional low-gain antenna on board which will be used to return data to Earth and this was demonstrated during the comet impacts with Jupiter in July 1994. Although only one ten-thousandth the strength of planned signals from the high-gain antenna, large amounts of valuable data are anticipated from the mission.

On 12 July 1995, a probe was released from Galileo which will travel the remaining 83 million kilometres to Jupiter independently then descend into its dense atmosphere transmitting data back to Galileo. On 27 July, a critical firing of Galileo's main engine was successful and took the spacecraft off a collision course with Jupiter. That engine will be fired again in December to place Galileo in orbit around Jupiter. ⊕

IMAGE OF DOWN-TOWN ATLANTA

No, this image was not snapped by a passenger after take-off from Atlanta airport but by a satellite a hundred times higher and moving a hundred times faster! For some time now the Russians have been earning hard currency by selling high-resolution images obtained from their spacecraft. This example, from a KVR 1000 camera which has a resolution of about 2m, is one of several sample images on CEN's WWW page on Internet and is reproduced here with their permission. http://cen.cenet.com/htmls/d2/sate.htm ⊕

BLUE LED DRIVER CIRCUIT

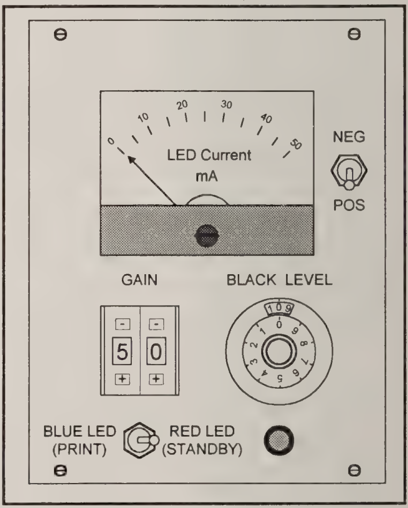
Drew McGuffie GM3CEA

Sometime ago, Henry Neale, asked me to evaluate the possibility of using the high output blue LED in place of a glow modulator tube (crater tube). The incentive in agreeing to Henry's request was the cost difference; the high output blue LED at twenty pounds showing a considerable saving on the glow modulator at one hundred pounds.

Initially, the blue LED was installed in the existing glow modulator circuit. Although it proved the feasibility of producing a picture, the residual current in the circuit was too high to allow the LED to reach the minimum marking current required. RIG member Tommy Gratton, GM3TGG, drew up a driver circuit to replace the glow modulator circuit and after prolonged testing, was found to produce pictures similar to that of the glow modulator.

My next request to Tommy was to add a POSITIVE/NEGATIVE facility. This will mainly be used to print the Meteor 3-5 type 120 rpm infra-red pictures in the same format as the NOAA and Meteosat, ie. black = warm and white = cold. It can also be used to produce full size negatives to make contact prints.

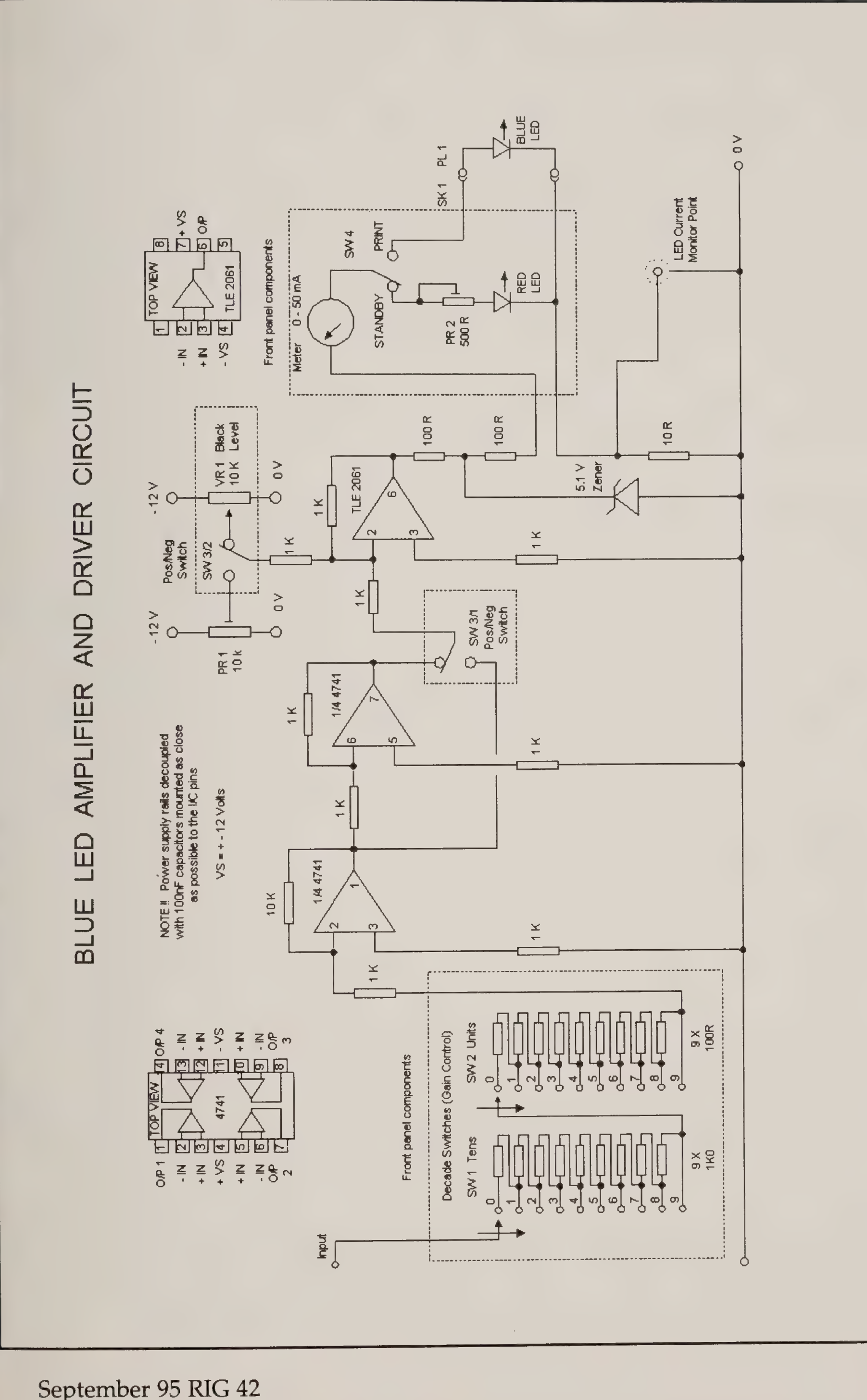
The input gain control (white level) consists of two decade switches with 1K and 100 ohm resistors. It has been found from experience that accurate resetting and adjustment of the white level is easily achieved with this arrangement. A ten-turn 10K pot with a multi-turn dial mechanism could be substituted if desired.



Blue LED amplifier panel layout

VR1 (black level) is adjusted to give the maximum marking current required by the photographic paper. This will vary with the type of picture being produced, the drum speed and rate of traverse. In the final version, for ease of resetting, VR1 was replaced with a ten-turn type. PR1 is adjusted to give the minimum marking current when switch SW3 is in the NEGATIVE position.

The red LED is useful in setting-up and phasing. PR2 is adjusted to match the current to that of the blue LED. SW4 switches over to the blue LED for printing. This switching arrangement was devised originally to safeguard the glow modulator tube and increase its life span.



Blue LED amplifier and driver circuit

The Zener diode connected between the junction of the two 100 ohm resistors and the 0 volt rail is chosen to limit the maximum current to about 20 mA which is well within the 30 mA maximum advised by the manufacturer. One cannot be too careful with the present cost of the blue LED!!

The circuit was constructed on 160 mm x 100 mm Eurocard with a 32-pin DIN 41612 edge connector. This slots into a 4 inch wide plug-in module and mates with a matching 32-pin socket in the back plane of an IEC 297 sub rack system. This width of module is necessary to accommodate the meter and other front panel components. The +12V and -12V regulated power supplies are mounted at the rear of the rack. This leaves plenty of space for a series of 2 inch wide modules containing the demodulator and signal conditioning circuits. At present the blue LED amplifier is being driven from the buffered output of the signal conditioning circuit as used by the crater tube amplifier.

The blue LED was mounted into an old type IF Coil Can about 2 inches long with a 3/4 inch x 3/4 inch cross section. The hole at the end of the can was the correct size to take the LED mounting clip and ring, and the 2 inch length was sufficient to mask the extraneous light from the LED. One side of the can was split down the centre and the resulting two halves bent outwards to form a flange. This in turn was bolted to a bracket with the LED behind a light gate with three aperture settings. Each aperture setting is preset to suit a particular picture format such as NOAA, Meteor etc. A lens assembly to focus the light on the drum completes the system.

No problems were experienced in building the unit from the drawings supplied by GM3TGG but be prepared for a time-consuming period of experimentation to adjust the unit for optimum performance. 🌐

ISLE OF WIGHT LOCAL RIG MEETING

Six of the island's 13 members attended the inaugural meeting on 17 June. Some had been receiving images for years whereas others were newly involved. Problems were discussed and in many cases resolved.

Two were involved in an imaging project with three students at Carisbrooke High School which, when completed, will become a permanent geography resource for the school.

Another meeting is planned for the autumn. 🌐

MORE ON TIMESTEP'S HRPT SYSTEM

Peter Wakelin

Elsewhere in this issue are two other pieces on this subject but many of you will have noticed that they were both written by the 'Timestep Team'. So is the system as good as they claim, or is it just a lot of advertising hype best disregarded? Being incapable of soldering anything much smaller than half-inch copper pipe I am very much a 'black-box' person and not a constructor so have to purchase ready-built equipment. Just how do some folk manage to solder those tiny coloured things together without setting fire to the plastic bits with the blow-lamp? This is just a brief, non-technical account of my experiences with Timestep's HRPT equipment.

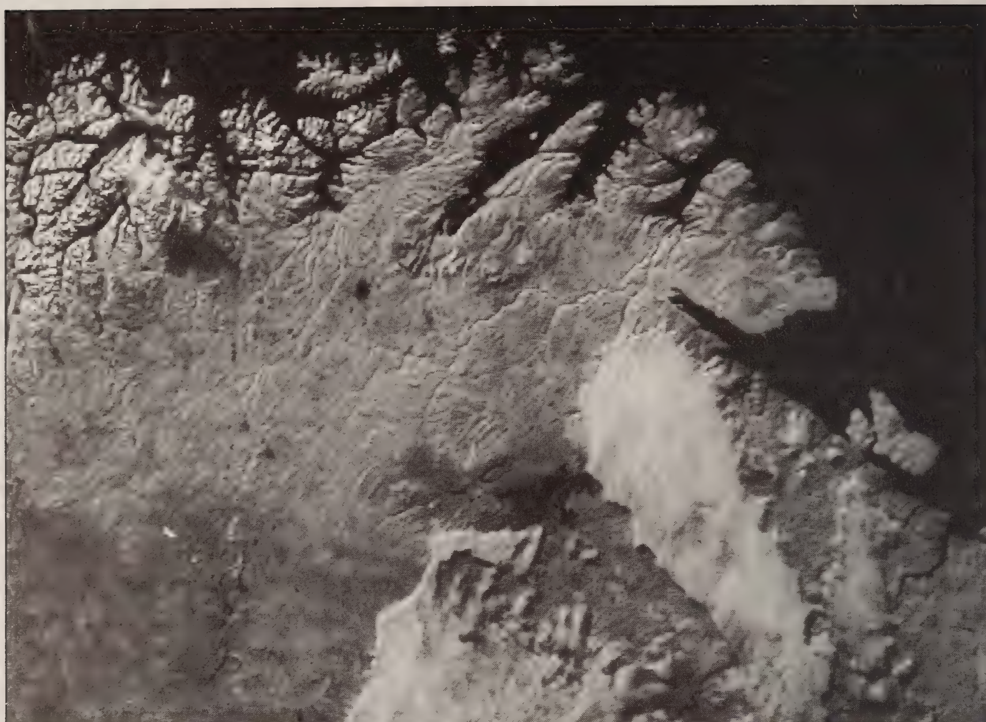
About 3 years ago I purchased the receiver, PC card and software, together with a circular feed-horn fitted with a single probe and a HEMT amplifier. Not wishing to have to replace my Yaesu 5600 Az/El rotator after every gale, I built a light-weight, low wind-resistance 1.2m dish from 12 'U'-section aluminium radials and a roll of galvanised steel mesh. I was very pleased with the system and could get noise-free images down to about 15 degrees elevation. Iceland was just within reach on a favourable pass.

The first significant improvement came when the full 10-bit data capture was introduced. In particular, the improvement on visible images at low levels of illumination was very noticeable. At the time the accompanying image of northern Norway was received, the sun was only 8 degrees above the horizon as seen from the centre of the image.

A year or so later, I changed to their dual-feed horn with combiner for circular polarisation and found I could get images from slightly lower elevations and, more importantly, could follow the near-overhead passes without brief losses near the zenith. Timestep's automatic tracking facility came on the scene around this time but I decided against buying it. I found no problem in tracking manually after a little experience unless the telephone rang at 80 degrees elevation!

More recently, a compact, helical feed was introduced and the PC card was completely redesigned. What a difference these two changes made! Iceland without speckles several times a day and Novaya Zemlya and the fascinating eddies often seen downwind of Jan Mayen Island are now within range.

Following suggestions from some users that their images sometimes lacked the clarity of some other systems, Timestep's software now incorporates non-linear contrast stretching and also 'Interpolation'. The former makes it very much easier to extract maximum detail from a scene without 'burning out' the whites (as is



demonstrated on the above image) and cubic interpolation really does improve clarity, especially at the higher zoom levels and at the image edges where geometric distortions are corrected.

I envy those people who can stick several hundred tiny components together and create something that actually works. I know several RIG members have succeded in building some parts of HRPT systems themselves but I am sure many more will be seriously considering buying Timestep's system or, at least, some components of it. ⊕

RIG*sat* RX1 - UPDATE
Ray Godden and Bryan Taylor

We have now had orders for more than 200 RX1 PCBs. These are some notes for those in the process of building the receiver.

There were some errors in the original PCB routing which were got around by modifications to the layout and subsequently by correcting the board. In some cases the modifications are not too obvious and have caused confusion to con-

structors. In case of doubt refer to the schematic, which is correct. The modifications are as follows:

1. R11 should be placed parallel to the short dimension of the board between TR3 gate 2 and source. Some copies of the component layout had this in error so please check that you have R11 correctly connected.
2. R25 is mounted vertically and link 'A' is connected to one of its leads.
3. Link 'F' connects R24 to R21.
4. IC4 pin 8 should linked to pin 4 (not necessary if the recommended CMOS 555CN is used).

Other points: The ground pins of IC1 must be soldered to the top (ground plane) side of the PCB also pin 9 of IC5. Care should be taken with the antenna connection or instability may result. It should be connected with coaxial cable, with the braid soldered to the ground plane near to the point where the inner is connected. Cirkit in some case have supplied L3 (14T5) with a screening can, this should be removed to increase inductance. In one case the crystal oscillator was at half the crystal frequency - this was corrected by changing the BSX20, which seem to have rather a wide spread of characteristics. If you have problems try changing C11 from 56pf to 39pf.

Other than the above we are not aware of any pattern of problems. If you are having difficulties call one of us to talk about it. You *can* make it work! ⊕

RIG*sat* RX1A - 5 CHANNEL UPGRADE FOR RIG*sat* RX1

Ray Godden & Bryan Taylor

The RX1A

A significant number of you have expressed interest in the 5 channel upgrade unit mentioned in RIG 41. Development of this is now almost complete. It takes the form of a small (8cm x 5cm) PCB that can be piggy-backed on the main board, mounted within the RX1 box or in a small additional box.

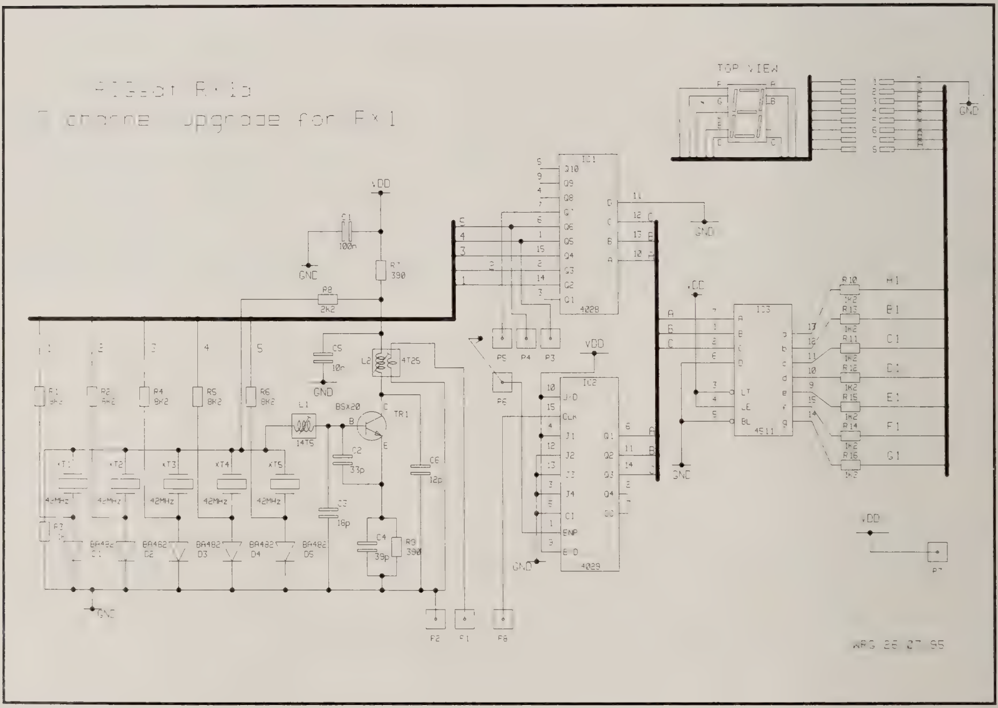
Schematic

The oscillator (TR1) is crystal controlled and is similar to that in the RX1. Scan control is by programmable counter IC2 which is clocked by the timer on the main board, allowing the existing logic to control operation. The counter output is decoded by IC1 which switches the crystals on in turn. When the counter reaches a count of 6 it is instantly reset to 1. If not all channels are required the count can be terminated at 3 or 4 by linking P6 to P3 or P4 instead of P5. IC3 decodes the counter output to drive a common-cathode seven segment display. L2 is a Toko MC111

4T25/1T25 coil. The original BSX20 crystal oscillator in RX1 is used as a buffer with the RX1A output fed to its base.

Connection to the Main Board

Remove XT1 and XT2, D1 and D2, L3, C10 and C11, R3 and R8. Replace C11 with 1n, L3 with 47R, D2 with 1n. XT1, XT2, D1, D2 and L3 can be used for RX1A - if they survived! Connect the output of RX1A (P1 and P2) by coaxial cable to what was the 'hot' end of D2, braid soldered to the ground plane. Connect P8 (clock) to pin 1 of the 4027 (IC5). Replace C31 with 100n to speed up the scan rate. Connect P7 to a suitable + 12V point on RX1. The original bi-colour LED can be used to indicate signal acquisition by connecting it, via a 1K8 resistor, between the 'hot' end of SW1 and +12V.



Supply of Printed Circuit Board

A PCB has been designed for this project and is in course of manufacture. It will be drilled, with plated-through holes and the components locations silk screened. The costs are £4.00 for UK members and £4.50 for overseas members. Delivery is expected early in October. The ordering procedure is the same as for the 'Shop Corner' items. ⊕

MEMBERS' LETTERS

Dear Peter,

Thanks to Michael Gill, Bryan Taylor and Ray Godden, I am now receiving some stunning APT images from weather satellites. The RIGsat-RX1 works a treat and any members who have not got a suitable wideband receivers should get out their soldering irons and get to work. The receiver is easy to build, so if you are short of cash and don't want to spend £100+ for another black box then order one now.

Yours, William Tracey, GM4UBJ, 4 Finnie Wynd, Motherwell, ML1 2JJ

Dear Peter,

Disasters always happen to other people, don't they? Don't you believe it! It happened to me and it could happen to you if you don't take care over what you plug into your computer.

Mains voltage got into my PC via a serial port and caused extensive damage. This is how it happened: I bought an old signal generator which went "Pop" when switched on. Later on, my PC failed to boot when switched on and smoke came from the fan vent. Investigation revealed the following damage: Burned tracks on the serial card; the chip connected to COM2 had blown; the IC controller chip had melted and one floppy drive was damaged. My satellite receiving equipment sustained some damage too.

The current from the mains via the signal generator followed this path: A wire from the mains switch was hanging free and in contact with with the chassis. The current passed down the earth lead to the mains socket block. The resistance to ground from the earth pins on this block was 15 Ohms due to a badly wired wall socket and this high resistance allowed high voltage on all earth lines from equipment connected to that socket. This included the receiver and interface unit, complete with its lead to the PC's COM2. The computer was plugged into another wall socket and the current flowed along the interface cable to ground through the PC's most intimate regions.

The moral of this tale of woe is to be aware of complacency. Do you really know what you are sticking into that mains socket? Do you know all the implications of plugging that gadget into your PC?

I now have an audio transformer between the PC and the radio and plan to drive

the other kit from a mains isolation transformer too, when pennies permit. New, untested gear will be tried out elsewhere initially. Oh, and that signal generator now works too.

Best regards, Tom Woolner, 52 Coleswood Road, Harpenden, Herts, AL5 1EQ. ⊕

NASA'S MARS CD-ROMS
Mike Cook, G8HBR

In the second part of my short series on NASA CDs I would like to look at a set containing images from Mars. The two Viking orbiters were active around Mars from 1976 until 1980 sending back masses of data.

Raw images are available as another data set but to my mind the highlight of NASA's collection is the Digital Image Map CD set. These 14 CDs were compiled by the US Geological Survey over ten years. The maps are called Mosaicked Digital Image Model or MDIM and are made from joining together or, as the Americans put it, mosaicking individual images. However, there is considerably more to it that simply joining the pictures together as the maps have a consistent scale. In order to squeeze this out of the raw images they have to be subject to all sorts of stretching and twisting or to give it its full name radiometric transformation. To solve this problem NASA has chosen to use a rather unusual form of projection; equal area sinusoidal projection. This has the advantage that each pixel covers an equal area in the image. There are also some conventional polar projections to allow you to get a better look at the ice caps at the poles.

The images come in a number of resolutions with the highest at 231m per pixel but all cover the same area which means that the higher resolution ones are much larger files, all of which are 8 bits per pixel. The larger area maps are not even direct photographs but air brush drawings and have a soft texture. File names have a certain logic; the first letter tells you what type of image it is, normally this is M for MDIM but there is T for digital terrain or height and S for shaded relief air brush. This is followed by a letter giving the resolution, for example, G has 1/64 degree per pixel and E has 1/16. Next comes the longitude and a letter indicating whether the following latitude is north or south of the equator. So a file called MG45N037 would indicate a mosaicked digital image with 1/64 degrees per pixel centred on latitude 45 degrees west longitude 37 degrees north.

Some of the image files are quite large, with a few at about 4Mb. The first six volumes cover the entire planet with each disk taking a certain range of longitudes. If you want colour then volumes 8 to 13 cover the same region but with a separate file for each of the red, green and blue images. You need some software that will

combine the separate files to give you a colour composite. However, there is not too much colour on Mars and to my mind these disks are the least exciting in the set. If you do want colour images readily, volume 14 contains GIF files which being compressed and only 8 bit, all fit onto one disk. These files are approximately 600K long and expand to about 1000 X 1000 so it's not every computer that can display the whole image. NASA has tried to get the colour as true as possible but they look a washed out, coppery colour. A word of warning here to those of you with Acorn equipment, you can't read this last volume on Acorn's CDFS but if you are running Acorn's PC emulator or 486 card, then you can read them under DOS. These last two sets contain multi-look images; that is the same place was imaged on more than one occasion which allows you to see any changes that took place over an interval of time. Changes are particularly noticeable over the poles where the frozen carbon dioxide ice caps make annual advances and retreats.

If you are going to get just one CD then volume 7 is the one to go for. It contains all the 1/64 degree per pixel images from the first six volumes and also height information files. These files can be used in conjunction with a program like Vistapro, to create perspective views of the planet from any angle. I can thoroughly recommend the first 7 volumes and also the last, but I have had less use out of volumes 8 to 13.

Also on the disks are numerous text files describing the Viking mission, a gazetteer of feature names and the image processing operations performed on the maps. As with most images, you derive more pleasure if you know what you are looking at. To this end I would recommend that you get a good book on Mars to supplement the disks. I would highly recommend 'Mars' by Peter Cattermole published by Chapman & Hall. This is quite a technical book but nevertheless excellent.

Disk ordering information: Mars Digital Image Model (MDIM)NSSDC ID: 75-075A-01f/083A-01c. Cost for 14 \$84.00 + \$13.00 per software package + \$30.00 handling per request + \$5.00 (overseas only) shipping. Image reading software is on the CDs or use IMDISP (DOS) or Image4PDS (Macintosh). Any subset or combination of disks may be requested. For addresses and further information see RIG 41 page 55. ⊕

SHAREWARE CORNER

Les Hamilton

I can scarcely believe that RIG 42 marks the start of my third year writing Shareware Corner - doesn't time fly! I must admit that it has been a most rewarding experience, and I've greatly enjoyed the correspondence with RIG members from all over the World. One of the most pleasing spin-offs from this activity is the shareware that sometimes accompanies these exchanges, and this quarter's offerings include two fine applications sent in by correspondents from Europe, SATELLIT (sic), a brilliant piece of satellite prediction, and PVE, a really excellent image viewer. Both applications break with "tradition" by originating from Germany rather than the USA.

PVE (PV243)

Yet another program originating in Germany, this is a DOS file viewer with almost all the features of that well-established favourite VPIC. The archive comes with two versions, PV (German text) and PVE (English text). In operation, the two are identical. PVE accepts the widest range of image formats I have ever seen for a single program (over 50), and includes GIF, TIF, JPG and Kodak photo-CD. To illustrate its versatility, it can even recognise and import .SAT images from Eumetsat Wettersatellitenbild (BTXSAT Austria)! The program offers a limited range of image enhancing features and conversions into the more common image formats. Registration is DM 60. Disk V-02

SATELLIT (SAT20)

This DOS program is a brilliant piece of satellite prediction software from Germany. The opening screen presents a list of satellites (up to 255) showing information such as azimuth, elevation and altitude, all updated in real time. There are also mouse-selectable options to display tabular predictions, an azimuth-elevation graph for your horizon, or the satellite's movement on a World Map. The latter screen affords useful information on AOS and LOS times, satellite latitude and longitude, as well as displaying the satellite footprint in motion, both in real time and accelerated motion. There are audible tones to indicate both AOS and LOS.

To my mind, this is a program to rival Traksat, PC Track and STS Plus. It is much less demanding on computer memory and is simpler to operate. The application comes with the file ELEMENTE.DAT, which is simply a file of two-line elements in NASA format. An important point here is that line-1 of the 2-line element sets

must be complete, as shown below for Okean 4. SATELLIT will not load the elements if all number groups are not present.

Okean 4
1 23317U 94066A 95068.20439943 .00000210 0.00000-0 28471-4 0 487
2 23317 82.5462 127.6727 0026223 150.9336 209.3325 14.73908136 21895

If you are using element sets with information stripped out, such as those published in RIG, or produced by PROsat II, then it is possible to add 'dummy' values with a text editor, simply using zeroes as shown below.

Okean 4
1 23317U 94066A 95068.20439943 .00000210 0.00000-0 00000-0 0 009
2 23317 82.5462 127.6727 0026223 150.9336 209.3325 14.73908136 21895

Finally, be sure to get the checksum character correct (see RIG 40 pp 13-15 on how to do this).

SATELLIT can also control a rotator control through one of the computer's parallel ports, which may prove of interest. There is an automatic mode as well as manual operation. This latter is effected by clicking the mouse on the satellite's position on the azimuth-elevation diagram, and pressing the <enter> key. Simple! Further details are contained in the file ROTOR.INI. I have endeavoured to provide a translation of the file as ROTOR.ENG. Any member with a better knowledge of German than mine is welcome to send me an improved translation if I have made errors.

The version on offer is freeware, and works only until the end of November, although updates are always available from the authors (including Internet by anonymous ftp to: ftp.tu-clausthal.de), but the best solution is to register the full version. The cost is DM 28, about £12, a pittance for such a sophisticated program. It is available on Disk RIG-42 only.

LOGSAT

LogSat for Windows is a satellite prediction program featuring multiple satellite monitoring and can simultaneously display a number satellites in separate tracking windows. Several different map projections may be selected and you can select views of the same satellite in Mercator, cylindrical or orthographic projections and watch the footprint as it moves in either real time, or speeded up.

Other features include a logbook linked with a national callbook, several antenna and ground wave propagation analysis routines, a locator converter section which

converts LOCATOR to latitude and longitude values (and vice versa). The program comes from Roberto Franceschetti of Naples, Italy, and can be registered for $25. Disk T-05

WINORBIT

Yet another excellent satellite tracking program for Windows with extensive on-line help. Features multiple satellite tracking (for up to 20 satellites). Each satellite can be presented in its own window. There is also a panel displaying azimuth, elevation, range etc. in real time. Although similar in many respects to LogSat, WinOrbit has the advantage of being freeware. Disk T-05

GDS 3.1F

Graphic Display System is yet another image viewing program for DOS and is very much like CSHOW and VPIC but claimed to be far better! GDS can display images, including 24-bit ones, produce thumbnails, convert, flip, rotate, crop, scale and dither some twenty image formats, including GIF, JPG, PCX, TIF, BMP, and TXT. Yes - it even displays text files! Rapid in operation, and fully mouse driven, GDS comes complete with hypertext help and a 103 page discfile manual. There is also a very easy to operate slideshow option. This shareware version is restricted to reading only the first 25 image files per directory, while printing is disabled. Both these options are enabled on registration, which looks well worth the $40 fee. Disk V-02

UPGRADE NEWS

New versions of Graphics Workshop for Windows (1.1p) and Paintshop Pro (V 3.0) are now available. Following the general trend nowadays, these applications continue to grow in bulk and sophistication and each now requires virtually an entire 1.44 Mb disk to itself. Accordingly, they can be ordered by requesting Disk GWS or Disk PSP respectively. The less bulky earlier versions, which should continue to meet most members requirements, remain available on Disk I-06.

A considerably enhanced VUPRINT V 3.3 is now available on new Disk V-02.

Gordon Train's Weather Satellite Tracker is now in version 4.5K on Disk T-03 and now features an audible alarm as each satellite comes into 'view'. Additionally, satellite positions are now updated on the map instantly rather than at one minute intervals.

JUNE ADDITIONS TO THE RIG PC SHAREWARE CATALOGUE

Disk T-05 *WinOrbit, *Logsat

Disk V-02 *GDS V 3.1, PVE, *VUPRNT33

Disk PSP *Paintshop Pro V 3.0

Disk GWS *Graphics Workshop V 1.1p

Disk RIG-42 Satellit, *WinOrbit, *Logsat, *GDS V 3.1, PVE, VUPRNT33

The reviewed shareware is offered as the RIG 42 compilation disk.

SHAREWARE TITLE CATALOGUE

Disk A-04: *Earth Centred Universe, Lunar Eclipse, Skyglobe, Skyview, Solar Eclipse Predictor, Solar System Finder.

Disk A-05: *Skymap - Planetarium that displays and prints star charts etc.

Disk C-02: Hamcomm, JVFAX-70, Packet Monitor, RTTY_FAX, Satcom.

Disk F-01: CUTNOAA, DATtoPA2, JOIN-PIX, NOATIFF, CHOP, REJOIN.

Disk I-04: *Image Commander, GIF Palette, GIFtoJPG, *Iphoto, JPEG5386, JPGtoGIF, *Paintshop Pro, *Vue Print.

Disk I-05: Graphics Workshop for DOS, IMDISP, Neopaint V 3.0.

Disk I-06: *Graphics Workshop for Windows, *Lview Pro, *Photolab.

Disk T-03: AOS, AOSUS, NOAATime, Predict, *SatTrack, Weather Satellite Tracker, Wpredict.

Disk T-04: Bird Dog 3, *PC Track, *STS Orbit Plus.

Disk T-05: *WinOrbit, *Logsat.

Disk U-02: Adjust Clock, BBC Time, Geo-chronometer, Clockwork, PC Configuration, Fast *Geoclock, Make PCB, PKunzip, Screen Thief, SSTV FAX.

Disk U-03: *RIG Journal Index, RIG Shareware Catalogue, HURRTRAK V 5.0 (1994 version), *WINSTORM, Weather Forecast.

Disk V-01: Compushow, GIFdesk, GIFEXE, GIFREED, QPEG, VPIC, *WINECJ, SVGA.

Disk V-02: *GDS V 3.1, PVE, *VUPRNT33
Belmont: *Belmont Image Technician (sophisticated image processing suite)

Programs requiring Microsoft Windows are indicated by an asterix (*)

HOW TO OBTAIN COPIES OF THE RIG SHAREWARE LIBRARY DISKS

Send up to a maximum of 6 formatted 1.44 Mb MS-DOS 3.5" disks per request to Les Hamilton, 8 Deeside Place, Aberdeen AB1 7PW, Scotland. Disks must be sent in a sturdy, re-sealable package such as a padded Jiffy bag (or a package within a package), and each separate request must be accompanied by:-

i) a self-addressed adhesive label
ii) stamps for the return postage
iii) coins (or additional postage stamps) to the value of £2.

Note that overseas members' return postage is free, but an exchange of shareware or satellite images in lieu is always welcome.

Any RIG Member coming across any new or updated versions of useful shareware is welcome to send them to me at the above address. Should you experience any problems running any of the shareware from the RIG Library, please enquire by letter, and I'll reply by return of post. ⊕

RIG ON INTERNET

Thanks to all those who responded to my request in the last issue regarding Internet access. We now know that at least 10% of RIG members have some degree of access to the net.

RIG's own WWW page is under construction and should be available by the time this issue is despatched. Unfortunately, the URL is not yet known but will be announced in RIG's weekly metsat status report distributed via Rick Emerson's WXSAT e-mail list. RIG members are encouraged to subscribe to this useful list by sending a brief message to wxsat-request@ssg.com Ed. ⊕

ORBITING UPDATE

ALL THE LATEST NEWS

POLAR-ORBITING SATELLITES

NOAA 9 continues to produce acceptable images in spite of its age. The APT transmitter is switched off at times of conflict with NOAA 14 but the HRPT remains on. The Microwave Sounding Unit and the Space Environment Monitor are inoperative and unlikely to be revived. On 3 August an anomaly developed and the craft went into safe-state. At the time of writing (4 August), the problem is being investigated. The HRPT transmitter is on but the AVHRR is not operating. A failure of the Manipulated Information Rate Processor has been suggested, in which case further imaging will be impossible.

NOAA 10 continues to image satisfactorily in channels 1 and 2 but the IR channels 3 and 4 sensors were damaged, possibly irreparably, by accidental exposure to sunlight. The APT transmitter remains off.

NOAA 11's AVHRR failed last September so no images are available but other systems are still in working condition. The SAR system is operational.

NOAA 12 continues as the prime morning-southbound craft with systems operating nominally with the exception of one channel of the Microwave Sounding Unit, which is exhibiting reduced gain and housekeeping telemetry errors on some channels of the Space Environment Monitor.

NOAA 13 suffered a total failure two weeks after launch.

NOAA 14 is the operational afternoon-northbound craft and is fully operational. Extensive calibration tests of the visible channels were carried out over the southwestern USA in June/July in conjunction with aircraft overflights.

NOAA K (NOAA 15 when in orbit) is due to be launched in early 1996. This and the following satellites in the series will have an additional channel, at 1.6 micrometres, in the Advanced Very High Resolution Radiometer. The existing channel 3 at 3.7 micrometres will be known as 3B and the new one known as 3A. 3A will operate during the daylight part of the orbit, then 3B will switch in when the Earth below is in darkness.

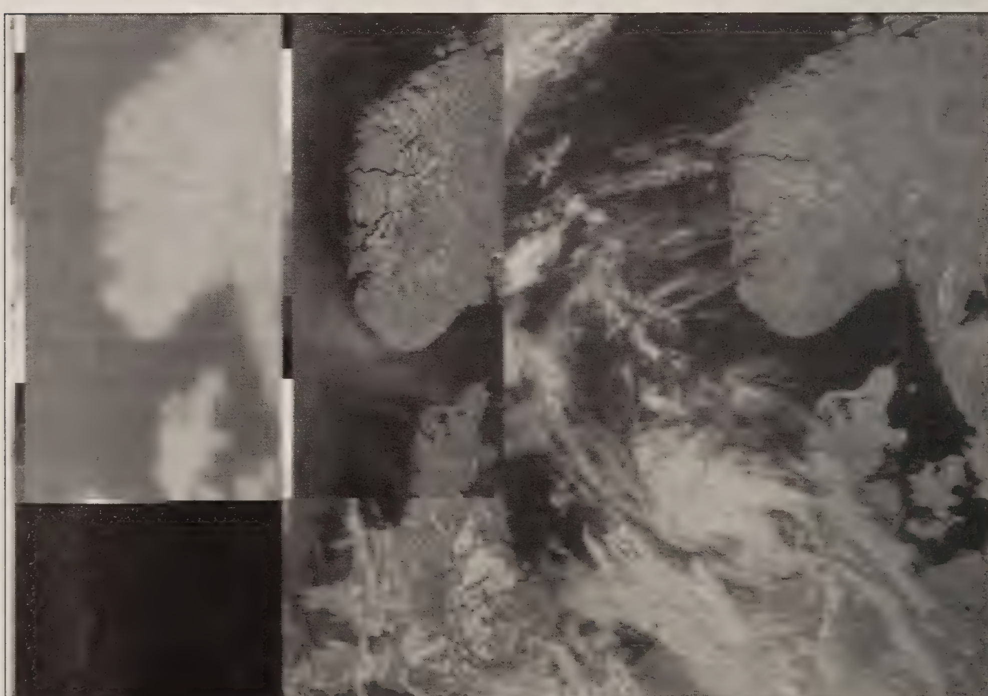
METEOR 2-21 has been on since late April but the images continue to be mostly poor.

METEOR 3-5 has been the only other Meteor to image recently, on 137.85MHz, the same as Meteor 2-21. It was switched off in late July but is expected to be active again from 9 August.

The last in the Meteor 3 series is due for launch in 1996 and in 1998 the first Meteor 3M is expected. These new ones will be in 98 degree orbits and will incorporate a HRPT-type system. They will orbit at a height of 950km, about 100km higher than the NOAA polar-orbiters.

OKEAN 4 continues to function well on 137.4MHz. The southbound afternoon passes in late July under good illumination produced some fine images of Europe at 2km resolution. Although switch-off occurred at high latitudes on most occasions, patient watchers were occasionally rewarded with good images of the UK. Les Hamilton captured the accompanying image which clearly shows that the 32mm radar and 8mm microwave imagers were switched off a minute before the visible scanner.

The Chinese Feng Yun-1 programme continues and FY-1 C is currently being designed. Launch is planned "for 1997 or 1998" into an 870km sun-synchronous orbit. Resolution of the 10-channel Multispectral Visible and IR Scan Radiometer



at the nadir will be 1100m. The High Resolution Picture Transmission of FY-1 C and D is named CHRPT. It will be BPSK/Bi-phase modulated with a bit rate of 1.3308 Mbps.

GEOSTATIONARY SATELLITES

METEOSAT 3 remains in standby mode near to GOES 8 but will be turned off and boosted out of geostationary orbit before the end of November.

METEOSAT 4 is at 10E and will be imaging at times until about late September in support of ground segment tests at the new control station in Italy. Anyone using a small antenna on Meteosat 5 and experiencing interference from Meteosat 4 could try pointing their antenna further to the west. Meteosat 4 will also be switched off and "thrown away" before the end of November.

METEOSAT 5 is the operational spacecraft at zero degrees longitude and continues to function well.

METEOSAT 6's software "fix" to correct errors introduced by a mechanical problem seems to have been successful but further tests on the water-vapour channel are being conducted. When completed, Meteosat 6 will become the backup for Meteosat 5.

Routine encryption will begin to be implemented from 1 September with all images (except the 6-hourly slots) encrypted from 1 December.

The aging GOES 7 at 135W will be replaced later this year by GOES 8 or GOES 9.

GOES 8 is the operating in the GOES-EAST position at 75W from where it can monitor the hurricane-spawning area of the tropical Atlantic. Image pixels were switched from 4 to 8-bit on the WEFAX service but the improvement was less than expected due to a poor signal to noise ratio.

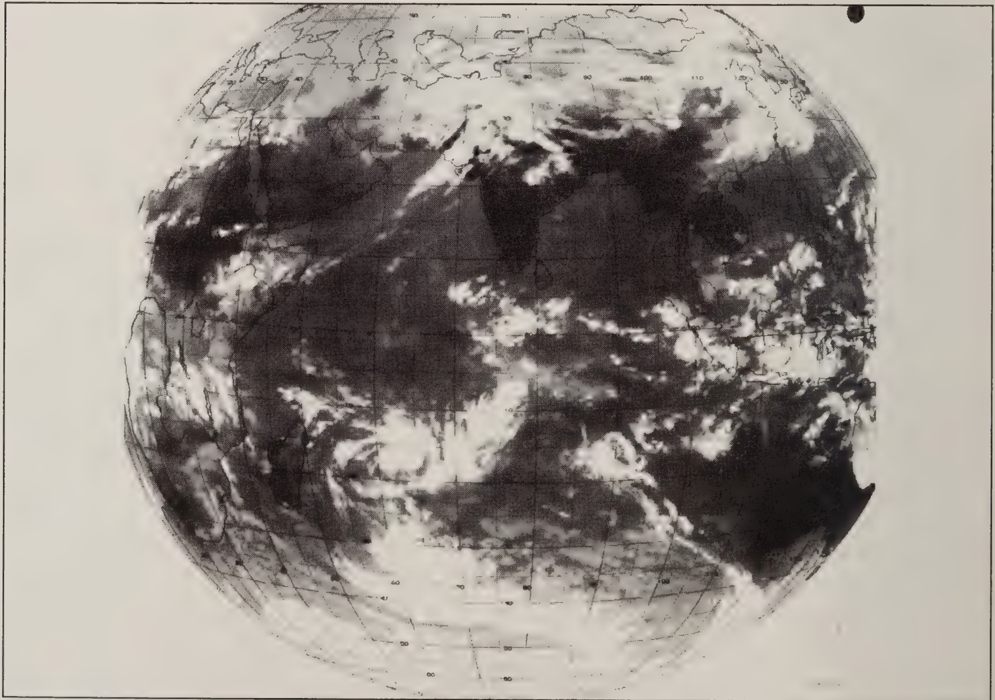
GOES 9's launch was delayed by 11 minutes for NASA to correct a problem with the launch destruct system on the rocket. Lift-off occurred on 19 May and it is currently being checked out at 90W. In the light of experience gained during the checkout phase of GOES 8, some minor changes were incorporated into GOES 9 before launch. Tests have shown that it will not experience the WEFAX degradation experienced on GOES 8. A decision on which of the two new generation craft will occupy the GOES-EAST slot when the GOES 9 checkout is completed in the autumn has yet to be made.

GMS 5 took over from GMS 4 in June as the operational spacecraft at 140E longi-

tude. It is similar to its predecessor, but the thermal IR window is now split into two and the visible images now extend into the near infrared. The latter change makes land appear a little brighter. GMS 4 is now the backup for GMS 5 and the old GMS 3 has been boosted out of geostationary orbit.

GOMS 1 is still not fully operational. It was reported at the CGMS-XXIII meeting in May that "Infra red imagery (10.5-12.5 micrometres) is considered to be quite accurate for distribution after subsequent geometrical and radiometrical correction. Due to malfunctions in onboard optical instrumentation partial utilization of visible images (0.46-0.7 micrometres) is discussing at the meantime". the Russians said they would issue a transmission schedule when the checkout phase was complete but, as far as is known, this has not happened yet. Arne van Belle in Rotterdam received an infrared image from GOMS 1 on 5 July (reproduced below) which he thought might be "live". However, Peter Wakelin recognised it as being identical to one of several presented in a paper at CGMS-XXIII in which the image was dated 15 March.

China continues work on its geostationary satellite programme following the destruction of the first satellite in an accident at the test site in April 1994. Launch of the second satellite to 105E is expected "after the second half of 1996"



Acknowledgements: I am grateful to the following for their assistance in compiling this report; Gordon Bridge and Michael Phillips, EUMETSAT; Richard Emerson; numerous NOAA staff and RIG members Arne van Belle and Dave Cawley.

KEPLER ELEMENTS

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NOAA 9
1 15427U 84123A  95215.87199763  .00000026                               3502
2 15427  98.9959 274.8768 0015316 130.3348  229.9168  14.1372125254865З
NOAA 10
1 16969U 86073A  95215.90669553  .00000046                               2594
2 16969  98.5117 217.3481 0012039 202.6294  157.4340  14.24950538461275
NOAA 12
1 21263U 91032A  95215.94634026  .00000115                               5847
2 21263  98.5849 238.7823 0013449 114.9191  245.3383  14.22546382219219
NOAA 14
1 23455U 94089A  95215.80725116  .00000067                               2681
2 23455  98.9045 157.9514 0010707 60.1967   300.0270  14.11525091 30534
METEOR 2-21
1 22782U 93055A  95215.59564156  .00000057                               4198
2 22782  82.5457 239.6139 0023316 146.9010  213.3613  13.83036391 97094
METEOR 3-5
1 21655U 91056A  95212.89144343  .00000051                               8208
2 21655  82.5506 187.3746 0011840 256.2793  103.7025  13.16840073190383
METEOR 3-6
1 22969U 94003A  95214.24576240  .00000051                               1863
2 22969  82.5639 126.2482 0014968 322.8562  37.1529   13.16730595 72943
OKEAN 4
1 23317U 94066A  95215.85942685  .00000119                                840
2 23317  82.5424 351.8428 0027998 37.1687   323.1453  14.73948191 43646
```

Frequencies: NOAAs 9/14 137.62MHz, NOAAs 10/12 137.50MHz
METEORs 137.30, 137.40 or 137.85MHz
OKEAN 4 137.40 MHz

Explanation of elements format above:

Line 1: NORAD catalogue number, International designation, Epoch, Decay rate (NDOT/2), Bulletin number (thousands omitted), Checksum (1 digit).

Line 2: NORAD catalogue number, Inclination, Right Ascension, Eccentricity (decimal point omitted), Argument of perigee, Mean Anomaly, Mean motion (8 decimal places), Rev. number, Checksum (1 digit).

RIG GIF LIBRARY

Peter Wakelin

No new images have been added this time. Images available are as listed in RIG 40, page 67 and RIG 41, page 70 where details on how to obtain images also appear. ⊕

DESCRIPTION OF COVER IMAGES

Front Cover:
The British Isles enjoyed more than the usual number of fine, hot days this summer. This composite image from visible and thermal infrared HRPT channels on NOAA 14, received on 23 June was supplied by Dave Cawley.

Inside Front Cover:
This image, one of the first from the Along Track Scanning Radiometer on ERS 2, is a false colour composite produced by combining uncalibrated detector counts from two of ATSR-2's visible wavelength detectors with a near-infrared channel. The image is dated 5 May and was prepared by ESA ESRIN and made available on Internet (URL: http://services.esrin.esa.it).

Inside Back Cover:
These two photographs, taken by Richard Harcourt at the Guildford Conference in April, show (top) a busy RIG stand and (bottom) the British National Space Centre's stand in the exhibition area.

Back Cover:
Your committee photographed by Richard Harcourt before the start of the agm at Guildford. From left to right: Peter Wakelin, Mark Pepper, Michael Gill, John Tellick, Les Currington, Ray Godden, Henry Neale, Mark Clarke, Sheila Newcombe and Frank Bell.

RIG HELPLINES

General enquiries		John Tellick	0181 390 3315
Meteosat information, NOAA information, Supplier complaints			

A copy of the Group's rules can also be obtained from John Tellick

Russian and Chinese satellite information		Peter Wakelin	01344 23200
HRPT		Peter Wakelin	01344 23200
PDUS		James Brown	01656 782632 *(not available on Sundays)*
Antennas and computing		John Boyer	01293 776862 *(7.00pm-9.00pm not Mondays)*
Schools/educational co-ordinator		John Tellick	0181 390 3315
Schools/educational enquiries	John Murray	Torquay	01803 386252
	Frank Bell	Godalming	01483 416897
	Tom Walter	Reading	01734 871330
	Bob Coombes	Haslemere	01428 642930
	John Din	Bristol	01454 773387
	Alan Wright	Norwich	01603 713449

Microcomputer specialists:

PC and printer problems	Mark Pepper	01344 777730 *(8.00pm-9.00pm)*
Commodore Amiga	Chris Pretty	01420 82752
Archimedes	Tom Walter	01734 871330

NOTE: We are grateful to the above members for offering their services to the Helpline. Please do not abuse the service by ringing them for queries other than those listed against their names.

All the helpline numbers listed under Schools/educational enquiries are situated in the south of England. John Tellick (address on page 2) would be pleased to hear from members in the educational field in other areas who would be willing to give help and advice. 🌐

REMOTE IMAGING GROUP

RIG SUBSCRIPTION - NEW MEMBER

If you would like to become a member and receive the Journal, photocopy this page, complete the form below, sign the declaration and send it to...

RIG SUB, PO BOX 142, Rickmansworth, Herts, WD3 4RQ, ENGLAND

The subscription rates for 1995 are...

UK membership	£10.00	Europe outside EC	£12.00
Europe EC	£12.00	Outside Europe	£14.00

Name ______________________________ Call Sign (if any)__________

Address. ____

____

__________________________________Post Code_______

Country ____________________ Telephone No.______________________

Are you receiving:
Polar-orbiting Weather Satellites _____ Geostationary Weather Satellites _____

Do you require back issues? (see Rig Shop Corner) ______

Amount Enclosed £________

Payment by Visa/MasterCard/Eurocard - there is no surcharge:

Card No.__________________________ Expiry date_________

Signed ____________________________________ Date ______________

Are you willing to have your name/address made known to members in your area? YES / NO. *(Delete as applicable)*

DECLARATION: I do NOT object to the Remote Imaging Group holding my Membership details on a computer.

Signed ____________________________________ Date ______________

RIG SHOP CORNER

ALL PRODUCTS ARE FOR SALE TO RIG MEMBERS ONLY, FOR THEIR OWN PERSONAL USE AND NOT FOR SELLING-ON.
IN THE EVENT OF PROBLEMS WITH EQUIPMENT PURCHASED FROM RIG PLEASE CONTACT RIG IN THE FIRST INSTANCE AND NOT THE MANUFACTURER.

All prices shown include post and packing except where marked

Receiving / Decoding Equipment	**UK/EC Price**	**Overseas Price**
RIG*sat*-RX1 two-channel 137MHz self-build receiver.		
PCB, crystal IF filter and FETs	£12.00	£13.00
PCB and FETs only	£8.00	£8.00
RIG DARTCOM Meteosat Downconverter.		
Assembled and tested module in tin plate box	£155.00	£132.00
Complete, assembled and mounted in weather-proof box.	£190.00	£162.00
RIG DARTCOM VHF Scanning Receiver. Assembled and tested module with LED channel number display.	£135.00	£115.00
As above but with LCD frequency read-out instead of LED channel number display. *Both the above items are modules and require a box, together with several components, switches, etc.*	£179.00	£152.00
RIG VHF Preamp. Includes a bandpass filter and is ideal for mast-head mounting. Assembled/tested module; needs boxing.	£18.00	£16.00
RIG 1695MHz Low Noise Amplifier kit. *Experienced constructors only.*	£29.00	£25.00
Martelec JVFAX Interface Unit	£78.00	£70.00
Connecting lead £5 extra (specify whether 25 or 9-pin required)		

Antenna systems	**UK Price**
RIG CROSSED DIPOLES A Turnstile type design, in kit form	£26.00
RIG/TH2 47-element YCV loop Yagi (1.7GHz)	£85.00
JAYBEAM 5X-Y 2m 5 element crossed Yagi, in kit form	£55.00

DISHES, FEEDS and BACKING PLATES not available by mail order. Contact Henry Neale. Tel:01945 440353

Crossed dipoles and the YCV loop Yagi can be dispatched overseas. Postage extra. Details on request from Peter Wakelin.

RIG Binders

UK Price £4.00 each, EC/European Price £4.50, Outside Europe Price £5.00.

CD-ROMS	**UK Price**	**EC Price**	**Other Price**
Meteosat No. 2, Weather in Motion	£12.50	£13.50	£15.00

Back Issues of RIG Journals

		UK Price	EC/Europe Price	Outside Europe Price
RIG 8-11	1987	£5.00	£6.00	£7.00
RIG 12-15	1988	£5.00	£6.00	£7.00
RIG 16-19	1989	£5.00	£6.00	£7.00
RIG 20-23	1990	£6.00	£7.00	£8.00
RIG 24-27	1991	£6.00	£7.00	£8.00
RIG 28-31	1992	£6.00	£7.00	£8.00
RIG 32-35	1993	£6.00	£7.00	£8.00
RIG 36-39	1994	£6.00	£7.00	£8.00

Note: Prices quoted are for a set of four, including Post and Packing.

RIG 1-7 are currently out of print. Owing to depletion of some issues, photocopies may be supplied. Individual issues are no longer available (hardship cases excepted).

Ordering Information

All items are available from the Editor, Peter Wakelin and include return by UK 1st class mail (except antennas and Journals). Items to non-UK addresses sent via airmail.

UK VAT is now applicable on sales to the following EC countries - France, Germany, Belgium, Portugal, Spain, Republic of Ireland, Austria, Sweden, Denmark, Italy, Luxembourg, Netherlands, United Kingdom (including Isle of Man). Members in these countries should use UK/EC price when ordering. EC members who are registered for VAT must forward their VAT registration No. to the Treasurer to enable them to receive VAT exempt goods.

As UK/EC prices now include VAT where applicable; receipts will be issued upon request. Remote Imaging Group VAT Registration No. 594 7483 83. Channel Isles: divide by 1.175 to remove VAT content.

UK members, By Cheque or Postal Order.

Overseas members, Pay by Bank Draft (drawn on a UK London-based bank) or Eurocheque(s). (Payments to a Maximum of £100.00 in any one Eurocheque). No local currency please.

All cheques made payable to *"REMOTE IMAGING GROUP"*.

Credit Cards Accepted (Access/Visa/Mastercard/Eurocard) Add 3% to Total. Available by MAIL ORDER from the Treasurer, Mark Clarke, 9 Park Lane, Bulmer Tye, Sudbury, Suffolk, CO10 7EQ, or FAX 01787 883141 (International +44 1787 883141).

Please state type of card, Card No., Expiry Date.
All Credit Cards authorised before goods are despatched.
(Note: Ordering by Credit Card does not mean instant despatch!)

LATE NEWS:

NOAA 9 (see page 67). MIRP failure confirmed. One battery also dead. Any further imaging now seems very unlikely.

RIG's WWW page on Internet (see page 66). The URL for our WWW page is:
http://www.bbc.co.uk/john_wxpics/rig/index.html

BULLETIN BOARDS

Orbital elements and other information of use to members are available from several electronic bulletin boards. The three listed below all offer free service and are available 24 hours a day. In addition to orbital elements (in both Amsat and NASA 2-line formats), the Timestep service include regularly updated weather satellite status reports indicating which ones are transmitting and their frequencies. The RIG board also offers a range of shareware programmes.

Telephone numbers:	RIG BBS	01945 440666 8bit, no parity, 1 stop bit
	Timestep BBS	01440 820002 8bit, no parity, 1 stop bit
	Dartcom BBS	01822 88249 8bit, no parity, 1 stop bit ⊕

RIG AT RALLIES

RIG has revised its rally diary for 1995. We shall be attending the following and look forward to seeing you. We will be showing RIG products and demonstrating imaging etc. ⊕

BARTG, Sandown Racecourse, Esher	10 September
Leicester	20, 21 October

SUBMISSION OF ITEMS FOR PUBLICATION AND COPY DEADLINES

Please send contributions, which should be original, to the Editor. Although typed and hand-written items are quite acceptable we would prefer longer pieces to be on a PC disk in one of the popular word-processing formats, ideally in Word Perfect. Drawings and diagrams may be submitted on disk, preferably in a Windows Meta File compatible format, but please send hard copy also. Diagrams and images must be in separate files and should not be embedded in documents. To reproduce well, satellite images must have a good range of tones. Contact the Editor for further information.

COPY DEADLINE FOR THE DECEMBER ISSUE: 25 OCTOBER 1995

Advertisers' copy is required by 25 October 1995 and should be sent direct to Michael Gill (address on page 2). ⊕

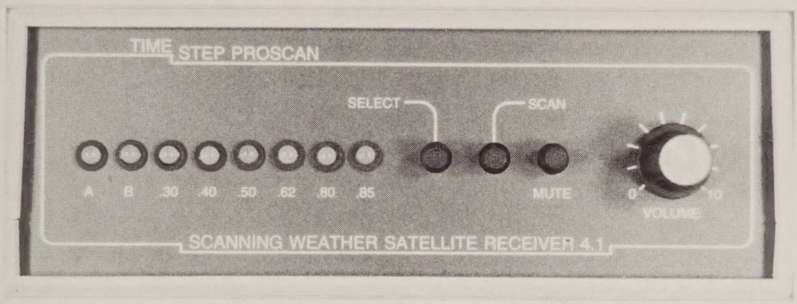
RIG*sat*-RX1

PCB for low-cost 137MHz receiver

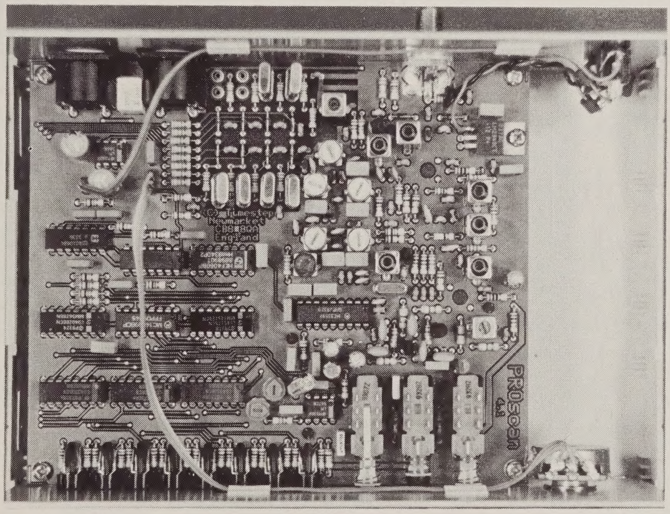
Michael Gill - G6HOM and Bryan Taylor - G8TPC have co-operated in designing and manufacturing a printed circuit board for the two-channel receiver described in RIG 35. The board is pre-drilled although some holes will need enlarging for component fixings. Scanning is incorporated with PLL signal verification. The performance of the receiver is defined by a high quality crystal filter, obtainable from RIG, giving particularly good adjacent channel rejection. All other components (excepting the channel crystals from McKnight) are available either from Maplin or Cirkit: a full parts list is included with the board. To reduce costs some of the capacitors which can only be bought in multiples of 10 are supplied with the PCB. Also included are the schematic, layout and instructions for building and alignment. Advice and help will be available in case of difficulty. Total cost (excluding case) is about £40.

For prices and ordering information see RIG Shop Corner.

Timestep Offer to RIG Members
PROscan Polar Receiver



What do you want from a Scanning Weather Satellite Receiver ? a) Intelligent squelch that only responds to weather satellites and is quiet when no satellite is present b) To be able to read the frequency directly from the front panel when it stops on a satellite c) To be able to "lock out" unwanted satellites d) Resistant to pager interference up to the pager transmitter itself (where of course the field strength is low e) Resistant to pager interference at 1 to 2 miles where the field strength is at a maximum f) An unconditional 12 month money back guarantee g) Full technical support directly from Timestep **and** h) the ability to control the receiver frequency from the computer so that you are sure that **all** passes can be received in your absence.



The PROscan receiver uses a lot of filtering, 3 coils in the pre-amp (optional), 4 coils in the RF amp (total 7 coils at RF), 3 coils in the oscillator, 1 matching coil at first IF, 5 ceramic filters at first IF, 5 coils at second IF (total 11 IF filters) and a quadrature discriminator for linearity and high ultimate signal to noise. A preamplifier is not required for short cable runs but adds extra selectivity and makes up for feeder loss on longer runs.
PROscan receiver £185.00 VHF Preamp in diecast box £20.00 **Computer controller** £125.00
UK postage £6.00 plus VAT at 17.5%

Timestep PO Box 2001 Newmarket CB8 8XB England
Tel. 0440 820040 Fax. 0440 820281

Trade Talk

** Autumn news to **RIG Members** from Timestep **

APT Equipment At the RIG conference, many people expressed surprise at the range of products we had. Silly people ! If they had phoned for our full colour catalogue they would have known that we supply more Weather Satellite parts than anyone. In fact our policy is "If you Can Dream It - Timestep can supply it !"

So, don't hang around, pick up the phone now ! AND read our adverts, they do change from month to month.

PDUS The good news is that once you have bought the Key (from the Met Office/Eumetsat) and the Key Interface from us at just £150.00, you will get free access to whole earth images every 30 minutes and 2.5KM European images also every 30 minutes. Expensive; but like having NOAA every 30 minutes only twice as good ! Read the review in the last issue from The Rev James Brown. The dish price has come down for this issue only !

Meteosat PDUS new RIG prices

1.8M dish (inc dish feed)	£280.00
Dish feed (included with the dish above)	£ 40.00
P-HEMT Preamplifier (only when ordered with PDUS RX)	£100.00
20M cable	£ 15.00
Extra 20M cable and line amplifier	£ 50.00
2 channel PDUS receiver	£400.00
PDUS PC/AT card and full software inc **colour animate**	£150.00
PDUS Key interface card	£150.00

HRPT Following intensive development we now have a helical feed that works as well, if not better, than the dual feed and combiners AND it's £100.00 less to use ! It's lighter and doesn't need such elaborate metalwork to hold the dish to the rotator, hence the dish price is down too ! And it's available without the ground stand that you can get cheaper from your local TV satellite supplier. The new **analogue** card is now out and gives images as low as 0.5 degree. The tracking controller comes with a modified version of Track II and works perfectly with all but directly overhead passes, giving you time to have a cup of coffee, read the paper, AND get the best images you can have.... at any price.

1.1Km resolution, 5 spectral bands, 10 bit data, 80Mb data files, false colour, multi-spectral colour from any 3 bands (requires multi-spectral view II) and the greatest fun and resolution your are ever going to get (well for 10 years at least).

These RIG prices for HRPT really are silly, we will hold them only until the end of this magazine, prices WILL go up, especially the Yeasu rotator that we are holding artificially low at the moment

NOAA HRPT new RIG prices

90cm dish, helical feed and all metal work to fit Yeasu rotator	£150.00	RHRPTDISH
Yaesu R5400 Az-El rotator	£400.00	RYEASU540
20M control cables and heavy duty connectors pre-fitted must be ordered at the same time as the Az-El rotator	£ 80.00	RHRPTCABL
Tracking unit and software for automatic operation (needs separate computer)	£150.00	RHRPTAUTO
P-HEMT Preamplifier (at this price only with HRPT RX)	£100.00	RPPHEMP
20M signal cable	£ 15.00	RP20M
6 channel (5 fitted) HRPT receiver	£400.00	RHRPTRX
HRPT PC/AT **analogue** card and full software	£150.00	RHRPTCARD
Complete system as above	**£1,445.00**	RHRPTCOM
Extra 20M signal cable and line amplifier	£ 50.00	RLINE
Helical feed for using your own dish	£ 45.00	RHRPTHEL

All prices plus VAT at 17.5% and carriage at £6.00 in Britain. Visa and MasterCard credit cards taken on orders over £25.00.

Timestep PO Box 2001 Newmarket CB8 8XB
Tel. 01440 820040 Fax. 01440 820281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